What are the relationships between the degree of pregnancy intention and key maternal and neonatal outcomes in the Mchinji District of Malawi?

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By

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Declaration of own work

I, Jennifer Anne Hall, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signed:…….. Date:……

Abstract

Background
Every year 85 million women experience an unintended pregnancy. Unintended pregnancies may pose increased risks to mother and baby but the evidence is scarce and methodologically limited. This research aims to fill the gap in our knowledge about the pattern of pregnancy intention and the relationships between pregnancy intention and miscarriage, stillbirth, low birthweight, neonatal death and postnatal depression in a low-income country.

Methods
I validated the London Measure of Unplanned Pregnancy (LMUP) in the Chichewa language and used it to assess the degree of pregnancy intention of 4,244 pregnant women in Mchinji District, Malawi. Pregnancy outcome was ascertained after the neonatal period. I analysed these data to examine the determinants of pregnancy intention and the relationships between pregnancy intention and pregnancy outcomes using multivariate hierarchical regressions. I conducted focus group discussions on postpartum family planning (PPFP).

Results
The Chichewa LMUP is valid in Malawi and shows a similar pattern of pregnancy intention to the UK. Young, unmarried women having their first child, older, married women who have completed their family or who have recently given birth and women who have experienced depression or intimate partner violence are at increased risk of unintended pregnancies. The more unplanned a woman's pregnancy is, the less likely she is to access adequate care. More planned pregnancies have a lower risk of postnatal depression and possibly stillbirth; there was no significant relationship between pregnancy intention and miscarriage, low birthweight or neonatal death.

Conclusion
To prevent unintended pregnancies, at-risk women should be targeted by family planning services. These services, particularly PPFP, need strengthening. Including the LMUP in routine antenatal care would identify women who are at risk of inadequate care uptake, stillbirth and postnatal depression. During pregnancy these women should be given additional support to mitigate these risks. They should be followed-up postnatally to detect depression and prevent future unintended pregnancies through PPFP.

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The data were collected by a total of 27 field workers over the course of data collection. They rose admirably to the challenge, learning very quickly about new concepts such as pregnancy intention and depression as well as how to take GPS readings and input data onto the mobile phones. The mode of data collection also posed quite a challenge for the three zone supervisors: Edwin Beni, Raphael Chikadza and Prestor Kubalalika. While it was far from plain sailing for any of us I could not have done it without you all and I wish you all the best in your future endeavours.

Finally in Malawi I would like to thank the District Health Officer, District Medical Officer and District Executive Committee for supporting this research

throughout and allowing me to conduct it in Mchinji. Also to the village chiefs for allowing us to collect data in their areas and, of course, to all the women who agreed to take part in the research. I hope that we will be able to use these results to make a real difference to their lives.

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Acronyms

95%CI	95% Confidence Interval
AAS	Abuse Assessment Screen
ANC	Antenatal care
aOR	adjusted Odds Ratio
BCG	Bacillus Calmette–Guérin
BME	Black and minority ethnic group
DHS	Demographic and Health Survey
DPT	Diphtheria, pertussis and tetanus vaccination
EDD	Estimated delivery date
EPDS	Edinburgh Postnatal Depression Scale
FGDs	Focus group discussions
GAF	Growth of American Families
GPS	Global positioning system
HIC	High-income country
HIV	Human immunodeficiency virus
HSA	Health Surveillance Assistant
IfWH	Institute for Women's Health
IGH	Institute for Global Health
IPTp	Intermittent preventative treatment in pregnancy
IPV	Intimate partner violence
IQR	Inter-quartile range
ITN	Insecticide-treated net
IUD	Intrauterine device
KI	Key informant
LBW	Low birthweight
LIC	Low-income country
LMIC	Lower-middle income country
LMUP	London Measure of Unplanned Pregnancy
MDH	Mchinji District Hospital
MEO	Monitoring and evaluation officer
MINI	Mini International Neuropsychiatric Interview

MMR	Maternal Mortality Ratio
MOOSE	Meta-analysis of Observational Studies in Epidemiology
MWK	Malawi Kwacha
NFS	National Fertility Study
NMR	Neonatal mortality rate
NSFG	National Survey of Family Growth
OPV	Oral polio vaccine
OR	Odds ratio
PACHI	Parent and Child Health Initiative
PCA	Principal components analysis
PDA	Personal digital assistant
PND	Postnatal depression
PPFP	Postpartum family planning
PRAMS	Pregnancy Risk Assessment Monitoring System
PTB	Preterm birth
RR	Relative risk
SES	Socio-economic status
SRQ	Self-Reporting Questionnaire
TPB	Theory of Planned Behaviour
TTV	Tetanus toxoid vaccination
UCL	University College London
UIP	Unintended Pregnancy
UK	United Kingdom
UMIC	Upper-middle income country
UNICEF	United Nations Children's Fund
USA	United States of America
VCT	Voluntary counselling and testing
WHO	World Health Organization

Section I Introduction and Methods

The first Section 'Introduction and Methods' contains five Chapters. The first Chapter introduces the research area and question, as well as setting out the aims and objectives of the research. Chapter 2 is an introduction to the definitions and measurement of pregnancy intention and Chapter 3 presents the systematic literature review and meta-analyses of the relationships between pregnancy intention and key maternal and neonatal health outcomes. The last two Chapters in Section I are the descriptions of the methodology for the recruitment and follow-up of the cohort and of the data management and analysis procedures respectively.

Chapter 1 Introduction

In this Chapter I outline the background to my research, my research question and hypotheses and the aims and objectives of my research. The research setting is described, giving general information on Malawi in terms of the population, economy, health and human development. Relevant information about Mchinji District, where the research was conducted, is also included. I explain how the research came about and my role in designing and conducting the data collection and analysis. The training I undertook, source of funding and ethical approval are also detailed. Finally, I outline the structure of the thesis.

1.1 Background

85 million women experienced an unintended pregnancy in 2012; 40% of all pregnancies globally (1). These pregnancies resulted in an estimated 42.5 million abortions, 11 million miscarriages and 31.5 million unplanned births (1). Whilst all pregnancies expose women to some risk, unintended pregnancies expose women to these risks unnecessarily and without them making the decision to take on these potential risks for the benefit of having a child. In low-income countries (LICs), pregnancy can carry an extremely high risk of morbidity and mortality; in 2012 approximately 286,000 women in

LICs died from pregnancy-related causes (2). That 114,000 of these women will not have wanted to become pregnant in the first place makes this even more of a tragedy.

A major contributing factor to the level of unintended pregnancy is the fact that 222 million women worldwide have an unmet need for family planning[i] (3). Increased use of contraception in LICs in the last 20 years has already reduced the number of maternal deaths by reducing unintended pregnancies (4). Fully meeting the need for family planning could reduce maternal deaths by a further 30% (4), neonatal deaths by 0.6 million per year and later infant deaths by 0.5 million per year, predominantly in LICs (3).

In order to meet the unmet need for family planning we need to develop a better understanding of women's pregnancy intentions and behaviours. Most current estimates of the levels of unintended pregnancy in LICs are derived from questions used in the Demographic and Health Survey (DHS). The DHS asks a single question of women up to five years after their last birth to determine whether that pregnancy was intended or unintended. Yet pregnancy intention has increasingly been recognised as a complex concept that encompasses *'affective, cognitive, cultural and contextual dimensions'* (p94) (5). The DHS methodology is unsatisfactory as it diminishes a complex concept to two categories, introduces recall bias and overestimates intention because reported intention is greater after delivery then during pregnancy (6). Moreover only live births are captured meaning further overestimation of intention as abortions are omitted.

Whilst DHS and similar surveys have provided useful information over the last 100 years, there has been increasing discussion of the limitations of these methodologies and of the need to develop a more sophisticated way of measuring the complex construct that is pregnancy intention (5, 7-13).

The London Measure of Unplanned Pregnancy (LMUP) is a new, psychometrically validated measure of the degree of intention of a current or recent pregnancy (8). It scores intention as a continuous variable on a scale

[i] Fertile, sexually active women not using a method of contraception despite not wanting more children or wanting to delay the next child have an unmet need for family planning.

of zero to 12, with each increase in score reflecting an increase in pregnancy intention. This tool has not been widely used yet, and had not been validated in a LIC prior to this work, but has the potential to greatly enhance our understanding of pregnancy intention.

Unintended pregnancies may pose an increased risk to both mother and baby but the evidence on this is inconclusive. A 2010 review found that scant attention had been paid to investigating the relationships between pregnancy intention, health behaviours and maternal and child health outcomes (14). The existing research is *'older and methodologically limited'* (p157) (14) and is predominately conducted in high-income countries; another review found *'persistent gaps in the literature, indicating a need for more studies in developing countries'* (p18) (15).

My research aims to help fill the gap in our knowledge about the relationships between pregnancy intention and important health outcomes for mother and baby in a LIC. To do this I will validate the LMUP in the Chichewa language in Malawi and then use it to assess the intendedness of a cohort of women's pregnancies. I will follow up these women after the end of the neonatal period[ii] to record the outcome of their pregnancy and I will analyse these data to explore the relationships between pregnancy intention and pregnancy outcome for mother and child.

The crosscutting nature of the benefits of family planning and the fact that these benefits extend across generations make it an extremely cost-effective intervention (16). Although funding had fallen and progress stalled, there has been renewed interest in family planning since the London Family Planning Summit in July 2012. To capitalise on this, to enhance the policy relevance of the findings of this research and to inform service provision, I will also undertake qualitative work relating to the reduction of unintended pregnancies through family planning.

[ii] The neonatal period is the time from birth to 28 days.

1.2 Research question and hypotheses

This research will take a mixed-methods approach to answering the question: **"What are the relationships between the degree of pregnancy intention and key maternal and neonatal health outcomes in the Mchinji District of Malawi?"** and considering ways to prevent unintended pregnancies or mitigate their impact.

My underlying hypothesis is that pregnancies that are less intended will be associated with an increased risk of adverse outcomes. Specifically, I hypothesise that pregnancies that are less intended will be associated with postnatal depression for the mother and miscarriage, stillbirth, low birthweight and neonatal death for the child. The proposed mechanism for such a relationship is that women whose pregnancies are unintended may be less likely to practice beneficial care and more likely to practice detrimental behaviours or experience adverse circumstances during the pre-conception, antenatal, delivery and postnatal time-periods than women whose pregnancies are intended. Psychological mechanisms such as stress and anxiety may also play an important role.

1.3 Choice and definition of primary outcomes

I chose the primary outcomes for the research given their importance for maternal and neonatal health, the theoretical basis for a role of pregnancy intention in influencing these outcomes and the feasibility of collecting reliable data on them. The limited time frame of the research Fellowship necessitated a focus on outcomes in the neonatal period.

Miscarriages are an under-studied outcome, as many studies focus on births, but they are important to women. Given my research design I was able to capture some miscarriages (early miscarriages were missed as explained in section 4.4) so I took the opportunity to do so. Stillbirths have been neglected globally, partly due to their omission from the Millennium Development Goals, but it has been estimated that 2.6 million stillbirths occur every year, 98% of which occur in low- and middle-income countries (17). Nearly three million neonatal deaths occur every year, also mostly in low-

and middle-income countries (18). Deaths in the first month of life are now the leading cause of under-five mortality at 44% (18). According to the United Nations Children's Fund (UNICEF) in 2013 almost 22 million babies were born weighing less than 2,500g (19), the definition of low birthweight. These babies have higher mortality and morbidity rates, poorer growth and cognitive development and are at greater risk of chronic diseases later in life (20). I combined these four important outcomes into a composite variable of 'adverse pregnancy outcome' to form the primary neonatal outcome, as explained in section 5.5.3. Due to the lack of a reliable way of assessing the gestation of the pregnancy, as there is no ultrasound in Mchinji District and information on gestation at delivery is not well-recorded in the child's health passport, I was not able to include pre-term birth as an adverse pregnancy outcome, even though it has previously been shown to be related to unplanned pregnancy (21).

While maternal mortality is falling globally it is still unacceptably high. However, it was not a feasible outcome for this research given its relative rarity. As mortality falls the focus will shift to morbidity, within which maternal mental health is an important but often neglected issue, hence I chose postnatal depression as my primary maternal outcome.

The definitions I have used throughout this thesis are shown in Box 1-1. The definition of miscarriage and stillbirth varies by setting; I have used the definitions recommended by the World Health Organization for international comparison.

Miscarriage	A pregnancy lost before 28 weeks' gestation
Stillbirth	A baby born with no signs of life at or after 28 weeks' gestation
Low birthweight	A baby born weighing less than 2,500g regardless of gestation
Neonatal death	A baby born alive but who dies within the first 28 days of life
Postnatal depression	Depression suffered by a woman in the first year after childbirth

Box 1-1 Definitions of primary outcomes

1.4 Aims

My research has four aims:

1. Validate the London Measure of Unplanned Pregnancy in Chichewa for use in the Mchinji District of Malawi.

2. Investigate the relationships between pregnancy intention and maternal and neonatal health outcomes in Mchinji District.

3. On the basis of findings in aim two, develop and conduct qualitative work to explore potential interventions to reduce unplanned pregnancies in Mchinji District.

4. Make recommendations for ways to reduce unintended pregnancies and mitigate their impact on maternal and neonatal health in Mchinji District.

1.5 Objectives

These aims will be achieved through the following objectives:

1. Validate the London Measure of Unplanned Pregnancy in Chichewa for use in the Mchinji District of Malawi.

    a. Develop an agreed, culturally appropriate translation of the LMUP in Chichewa.

    b. Field test the Chichewa LMUP on at least 100 pregnant women in the Mchinji District of Malawi.

    c. Retest at least 50 women to assess the reliability of the Chichewa LMUP.

   d. Analyse the data using classical test theory to assess the validity of the Chichewa LMUP.

2. Investigate the relationships between pregnancy intention and maternal and neonatal health outcomes in Mchinji District.

   a. Collect data on pregnancy intention from at least 4,000 pregnant women in Mchinji District.

   b. Follow up these women at around six weeks after delivery to collect data on their health, the outcome of the pregnancy, the health of their baby and utilisation of antenatal, delivery and postnatal care.

   c. Analyse quantitative data generated to test key hypotheses on the relationships between pregnancy intention, antenatal, delivery and postnatal behaviours, and key maternal and neonatal health outcomes.

3. Develop and conduct qualitative research to explore potential interventions to reduce unplanned pregnancies in Mchinji District.

   a. Analyse the antenatal data from aim two to identify risk factors for unplanned pregnancies and potential interventions.

   b. Conduct focus groups with men and women in Mchinji District to explore an issue around unplanned pregnancies and potential interventions.

   c. Manage qualitative data in Nvivo software and analyse it using Framework analysis.

4. Make recommendations for ways to reduce unintended pregnancies and mitigate their impact on maternal and neonatal health in Mchinji District.

   a. Bring together the findings from aims two and three to make recommendations on the prevention of unplanned pregnancies.

   b. Bring together the findings from aims two and three to make recommendations on the management of women with unplanned pregnancies.

1.6 Location and context

1.6.1 Geography, population and economy

This research was conducted in Malawi, a landlocked country in sub-Saharan Africa (shaded dark green in Map 1-1). It is bordered by Tanzania to the northeast, Mozambique to the southeast and southwest and Zambia to the west.

Map 1-1 Location of Malawi and its neighbours

Malawi is divided into three regions: Northern, Central and Southern, shown in Map 1-2. The capital city is Lilongwe, which is located in the Central region. The three regions are divided into 28 districts and each district is subdivided into traditional authorities, presided over by chiefs. Each traditional authority is composed of a number of villages each presided over by a village headman (22).

Map 1-2 Map of Malawi showing the three regions and the districts within the Central Region

Malawi is an ex-British colony, gaining its independence in 1964. Since then the population has grown rapidly from 4 million in 1966 to 13.1 million in 2008, 65% of whom are under 25 years old (23). Even assuming a fall in the total fertility rate,[iii] the population is expected to double to 26 million in the next 15 years. About 84% of the population live in rural areas, most of whom are subsistence farmers (23). Nationally the main tribe is Chewa (36%) although this is more pronounced in the Central region (70%) (22).

Malawi's gross national income per capita is 774 international dollars. Nearly three-quarters of the country live below the international poverty line of $1.25 (in purchasing power parity terms) a day (24). The economy is primarily based on agriculture, which contributes over 30% of the gross domestic product. Malawi's major exports are tobacco, tea and sugar (22). However, crop failures are frequent due to high climate variability, poor soil fertility and a lack of agricultural inputs such as fertiliser (25), making the government's budget highly volatile.

[iii] The total fertility rate is the average number of children that a woman would have over her lifetime if she were to experience the current age-specific fertility rates through her lifetime.

About 40% of Malawi's budget has typically come from international aid but this has reduced dramatically in the last four years due to turbulent politics and strained international relationships. During the course of this research inflation was running at between 21.2% and 39.8% (26) and the currency, the Malawi Kwacha (MWK), devalued from MWK 220 to GBP 1 at the time of budgeting to around MWK 650 to GBP 1 at the end of the project.

1.6.2 Health and human development

The United Nations' Human Development Index represents a broader definition of development than traditional indicators of economic growth. It is a composite measure of three dimensions of human development: health, education and income. Malawi currently ranks 174th out of 187 countries on the Human Development Index and is below the regional average for sub-Saharan Africa (24). That Malawi is poor even in comparison to its sub-Saharan neighbours highlights how disadvantaged the population is.

Life expectancy is just 55.3 years and there is an HIV prevalence of 10.8% in those aged 15-49 (24). According to the Malawi 2010 Demographic and Health Survey (DHS) the under-five mortality rate is 112 deaths per 1,000 live births and the maternal mortality ratio is 675 deaths per 100,000 live births (22), though others have made higher estimates of the maternal mortality ratio (27). The total fertility rate is 5.7 children per woman, higher than the total wanted fertility rate of 4.5 children per woman (22). The contraceptive prevalence rate for married or unmarried sexually active women is 33% for modern methods and 26% of married women have an unmet need for family planning (22). Of particular relevance to this research is that 45% of pregnancies are classified as unintended by the DHS. Unintended pregnancies often result in abortion but abortion is illegal in Malawi, except to save the woman's life[iv] (28). It has been estimated that in Malawi in 2009 there were 23 induced abortions per 1,000 women aged 15-44 (29), most of which will have been unsafe abortions, contributing significantly to maternal mortality.

[iv] This law dates from 1930, when Malawi was a British colony.

Family planning services are provided free of charge at government health facilities in Malawi. However, women face opportunity costs, such as the time involved to travel to the clinic and wait to be seen, and real costs, such as for transport. There are also private clinics such as 'Banja la Mtsogolo' (translated as 'Future Families'), a Marie Stopes International partner. Many Catholic missionary hospitals remain across Malawi; these facilities generally do not provide family planning services.

1.6.3 Research setting

The high total fertility rate, large proportion of unintended pregnancies and high levels of mortality described above make Malawi an excellent setting for research into the implications of pregnancy intention for maternal and neonatal health. This research was conducted in the Mchinji District of Malawi, a native Chichewa speaking district in the Central Region. Mchinji District has borders with the districts of Lilongwe to the southeast and Kasungu to the northeast, as shown in Map 1-2, and has international borders with Mozambique and Zambia to the south and west. The population in 2012 was 530,218, 90% of whom are subsistence farmers, with 23% of the population (121,950) being women of childbearing age (30). Chewa is the main tribe and most communities are patrilineal.

The following data are taken from the Malawi 2010 DHS (22). The total fertility rate in Mchinji District is 6.3 children per woman, 0.6 children more than Malawi as a whole, yet the total wanted fertility rate is 4.6 children per woman, almost the same as the national figure. Crudely speaking this means that women are having almost two more children than they want, suggesting that there is a high proportion of unplanned pregnancies in Mchinji District. The neonatal mortality rate is 30 deaths in the first 28 days of life per 1,000 live births and the under-five mortality rate is 119 deaths per 1,000 live births. 29.3% of married women have an unmet need for a modern method of contraception, slightly higher than national figures.

Overall Mchinji District is a very average district when compared with the national figures for most indicators, meaning the results of this research should be generalizable to other areas of Malawi. The higher total fertility

rate, larger gap between total and wanted fertility rates and higher unmet need for contraception in Mchinji District make it an ideal setting for this research.

In Mchinji District I worked with the MaiMwana Project.[v] MaiMwana Project was established in 2002 as a collaboration between the Kamuzu Central Hospital Department of Paediatrics, Mchinji District Health Office and the UCL Institute for Global Health. It is a community-based organisation that aims to reduce maternal and child mortality and morbidity in the district through sustainable community-based interventions, health service strengthening and research.

1.7 My contribution

I developed the initial research question on the relationships between unintended pregnancies and adverse outcomes over a period of several months in 2010. I discussed this idea with Professor Costello of UCL's Institute for Global Health (IGH) where we decided that, from the range of IGH links available, the most suitable setting to investigate this question would be Malawi. He put me in touch with key people at MaiMwana Project as well as with Professor Address Malata who became my local supervisor. Professor Costello also introduced me to Professor Stephenson of the UCL Institute for Women's Health (IfWH) as a potential primary supervisor given her area of expertise in reproductive health and recent collaboration with IGH on a grant application relating to unmet need for family planning. Professor Stephenson brought in Dr Andrew Copas, an experienced statistician, as my secondary supervisor and introduced me to Dr Geraldine Barrett, the developer of the London Measure of Unplanned Pregnancy (LMUP), who acted as a collaborator.

I worked up the idea and presented my proposed research to the Wellcome Trust Global Health Bloomsbury Group in March 2011. The group approved my proposal to go forward for a Wellcome Trust Research Training Fellowship application and gave very useful critique and suggestions.

[v] http://www.maimwana.org

Professor Andrew Prentice of the London School of Hygiene and Tropical Medicine gave particular advice on the use of anthropometry and imputation for missing low birthweight data. I then worked closely with colleagues at MaiMwana Project in Malawi to develop the methodology and budget, including spending a week at MaiMwana Project in May 2011, before submitting the application to the Wellcome Trust in June 2011. I was interviewed and awarded the Fellowship in December 2011 and started at the end of April 2012.

I prepared and submitted the applications for ethical approval to both the UCL Research Ethics Committee and the University of Malawi's College of Medicine Research Ethics Committee, including writing the information sheets and consent forms. I submitted the required annual reviews throughout the project. I also completed all the required data protection, health, safety and risk assessments and insurance forms for UCL.

As this was an entirely new project for MaiMwana I had to recruit and train my own team and set up all the processes for recruiting and managing the cohort and the data, as described in Chapter 4. I stayed in Malawi for the duration of the work to validate the LMUP in September-October 2012, from translation to collection of re-test data. Dr Barrett advised me on the methodology for the validation work.

I carried out the literature reviews to inform the sample size calculation and questionnaire content. I then developed the questionnaires and did all the software programming required for these to be conducted electronically. Dr Stewart, a consultant psychiatrist with extensive experience in Malawi advised me on aspects relating to the measure of previous and current mental health status. I was present in Malawi from January-May 2013 to recruit, train and oversee the initiation of the project. Once data collection was in progress I split my time between Malawi and my home in London but was in very regular contact with my team and MaiMwana Project management. I monitored the data collection weekly and worked continuously on data cleaning.

I developed the analysis plan with advice from Dr Barrett on issues specifically related to the LMUP and from Dr Copas on the general analysis. Dr Jolene Skordis-Worrall advised me on the principal components analysis of my asset-based measure of socio-economic status. Dr Barrett and Dr Copas both provided input on the choice of regression model for the analysis of the determinants of unplanned pregnancy but ultimately I researched and made my own decision. I decided to pursue a hierarchical approach to all the analyses based on my reading in this area. I liaised with Dr Copas while working on the analysis to review my progress, discuss my decisions and to resolve queries. All analyses were conducted using Stata 13 (StataCorp. 2013) except the validation of the LMUP where Stata 12 was used. I wrote all the Stata .do files for all the analyses, choosing which statistical tests to use and when, and carried these out and interpreted them myself. I created all the maps in this thesis using the open-source QGIS software (31).

For the qualitative work, I drafted the topic guides for the focus group discussions and then trained the facilitators on them. Dr Barrett reviewed the topic guides. I attended all the focus group discussions, though they were conducted in Chichewa. I worked with my staff, who transcribed and translated the discussions, to ensure that the transcriptions were complete and that I fully understood the translations. I managed these data using QSR International's NVivo 10 software. I developed the thematic framework from the topic guide and relevant literature and coded all the transcripts myself. I then charted and summarised the data into a series of matrices and used these to develop my analysis.

I also managed the budget and procurement and completed quarterly financial reports for the funds spent in the previous quarter and requested for the forthcoming quarter. I line-managed the three project supervisors who in turn line-managed the data collectors with my oversight.

1.8 Training

I undertook a range of training in order to be able to carry out the work involved in this research, which is fully detailed in my UCL research student log. Key training of relevance included 'Advanced Statistics for

Epidemiological Analysis' (a two-week course) and a course on the use of Geographical Information Systems at the London School of Hygiene and Tropical Medicine, 'Longitudinal Data Analysis' and the management of missing data at UCL and qualitative methodology and Framework analysis courses at the National Centre for Social Research. I also attended generic training courses on topics such as project management, communication skills and networking.

1.9 Funding and timeline

A three-year personal Research Training Fellowship from the Wellcome Trust, award number 097268/Z/11/Z, met all training, salary and field costs for this research. The award letter is included in Appendix A. A timeline of the research throughout the three years of the Fellowship is shown in Appendix B.

1.10 Ethical approval

The UCL Research Ethics Committee and the College of Medicine Research Ethics Committee at the University of Malawi granted ethical approval for this research, reference numbers 3974/001 and P.03/12/1273 respectively. The approval letters are included in Appendix C.

1.11 Structure of thesis

This thesis is comprised of 12 Chapters in three Sections. The first Section, 'Introduction and Methods' contains five Chapters, including this one. Chapter 2 is an introduction to the definitions and measurement of pregnancy intention. Chapter 3 presents my systematic literature review and meta-analyses of the relationships between pregnancy intention and key maternal and neonatal health outcomes. Chapter 4 and Chapter 5 are the descriptions of the methodology for the recruitment and follow-up of the cohort and of the data management and analysis procedures respectively.

Section II is the 'Results' Section. The first Chapter in this Section, Chapter 6, is based on a published article, of which I am first author, describing the methodology and results of the validation of the London Measure of

Unplanned Pregnancy in Chichewa. Chapter 7 gives the recruitment profile and a descriptive analysis of the women in the cohort and Chapter 8 looks at the factors associated with pregnancy intention in univariate analyses, taking this forward to develop a multivariate hierarchical model for the determinants of pregnancy intention. Chapter 9 describes the postnatal follow-up of the cohort and presents a descriptive, univariate analysis of the antenatal, delivery and postnatal behaviours and pregnancy outcomes of interest. Multivariate hierarchical models are developed in Chapter 10 to explore the relationships between antenatal pregnancy intention and pregnancy outcomes. The last Chapter in this Section, Chapter 10, describes the methodology and results of focus group discussions conducted around the issue of postpartum family planning and my rationale for choosing this topic.

The final Section, Section III, sets out the 'Conclusion and Recommendations'. Here the findings from across the thesis are drawn together and their implications discussed. Recommendations are made for further research as well as for service delivery and policy change. I outline the papers that I plan to submit from this thesis as well as my dissemination plans.

1.12 Chapter summary

This Chapter has given some background to the area of research and has presented the research question, the hypotheses and the aims and objectives. I have described the research setting and my role in the development, conduct and analysis of the research. The structure of the thesis has been outlined. In the next Chapter I will describe the theory, concept and measurement of pregnancy intention.

Chapter 2 The theory, concept and measurement of pregnancy intention

This Chapter introduces the concept of pregnancy intention and the terminology associated with it. The history of the measurement of pregnancy intention is outlined, describing the different questions, methodologies and theoretical basis used over time. These measures are critiqued and the development of a new measure, the London Measure of Unplanned Pregnancy, is described as an attempt to overcome some of these limitations. The Chapter concludes by explaining how pregnancy intention will be measured in this research and why.

2.1 The rationale for measuring pregnancy intention

Understanding and being able to accurately measure pregnancy intention has multiple applications. Arguably, the most important is in using this information to support women and their partners to make and actualise their own decisions regarding whether, when and how many children to have. Other potential uses include understanding fertility and fertility-related behaviours, as well as forecasting fertility and assessing unmet need for family planning (32, 33). It can also be used to help design family planning programs or community-based programmes to prevent unintended pregnancy, as well as to evaluate their effectiveness (34, 35).

On a population level, fertility forecasting is important for governments and service providers who need to know how many people require which kind of services in the short- and long-term. This ranges from the immediate needs for contraception for those with a desire to delay or terminate childbearing, to the healthcare needs of women going through pregnancy, from pre-conception to postnatal care. Longer-term it extends to the future immunisation and health requirements of their children and, subsequently, the need for schools, teachers and jobs.

On an individual level, and in terms of a woman's reproductive life course, discussions with women about their future pregnancy intentions can enable the health service to support them to achieve these intentions. This means

providing contraceptive services to delay, space or terminate childbearing or, when the woman decides to stop using contraception and become pregnant, providing pre-conception care and counselling on folic acid supplementation, alcohol, tobacco use, nutrition and healthy weight, exercise, safe conception and the importance of early attendance at antenatal care.

2.2 The definition and measurement of pregnancy intention

The understanding of the concept of pregnancy intention has evolved in parallel with attempts to measure it. Therefore to answer the question 'what is pregnancy intention?' this section reviews the development of both. Much of the history presented here is from the United States of America (USA) as this is where the bulk of the methodological work was done in the 20th Century (36) but where relevant studies have been conducted in the United Kingdom (UK) these are also discussed. This historical context is relevant to the measurement of pregnancy intention in low-income countries because it is from this work that the measures currently used in these settings have been developed.

2.2.1 The terminology of pregnancy intention

The most commonly used terms in the field of pregnancy intention are '(un)intended', '(un)wanted', '(un)planned' and 'mistimed' pregnancies. '(Un)wantedness' and '(un)intendedness' are other synonyms frequently used. The generally accepted definitions, originating in the USA and used in their national surveys and most subsequent research, are shown in Box 2-1 (37).

Intended pregnancy – a pregnancy that occurs at the right time (or later than desired due to difficulties conceiving). Essentially synonymous with a **planned pregnancy**.

Unintended pregnancy – any of the following:

- **Unwanted pregnancy** – a pregnancy that occurs when no (more) children are desired;
- **Mistimed pregnancy** – a pregnancy that occurs earlier than expected but would have been desired at a later time; or
- **Unplanned pregnancy** – a pregnancy that occurs while the woman is using contraception, or when she was not using contraception but did not desire a pregnancy.

Box 2-1 Definitions of common terminology in pregnancy intention research

Despite these definitions there has been a general lack of clarity in the terminology used in this area, with researchers often failing to define their own use of the terms and using different terms interchangeably (10).

The confusion over these terms is due to a number of reasons, as will become clearer throughout this Chapter. Firstly, pregnancy intention is not as simple a concept as originally thought (explored in section 2.2.5) and therefore there has been a lack of clarity in what is being measured by 'pregnancy intention' questions. This has led to questions about action-orientated components, such as planning, being measured by some and affective-orientated components, such as desire, being measured by others, yet all being reported using the same categorisations of intended or unintended pregnancies.

Secondly, there has been a change in the conceptualisation of unintended pregnancy over time, from unintended pregnancies at the end of reproductive life (excess fertility) to those at the beginning. This is a fundamental difference as it could be argued that the decision to become a mother is a much more complicated decision, with more profound consequences, than the decision of whether to have two or three children given that you already have at least one. As Luker says *'what is really being tapped is the willingness to enter a new social role, not how extended that role should be'* (p248) (38). Despite these societal changes, the terminology

has not adapted i.e. the same terms that were used for excess fertility in the early 20th Century are being applied today to early unintended pregnancies. This is pertinent to the discussion in section 2.2.5.2 about the dimensions of pregnancy intention as well as to the critique in section 2.3.4 of measures of intention that dichotomise all pregnancies into intended or unintended with no regard for potential differences within unintended pregnancies.

Thirdly, some researchers have incorrectly conflated unwanted *pregnancies* with unwanted *children*. As we will see, it is completely plausible for unwanted pregnancies to result in wanted children. Finally, women may not use these terms spontaneously and for some women the concept of planning a pregnancy may not be meaningful (39). Women may therefore apply these terms differently to their own pregnancies than researchers would expect (9, 40), which would hardly be surprising given the lack of conceptual clarity.

Throughout this thesis I will use the terms 'unintended' or 'unplanned' pregnancy (and their opposites) as synonyms, without the distinction regarding contraceptive use outlined in Box 2-1 above. Where I use the terms 'unwanted' or 'mistimed' it will be in keeping with the definitions in Box 2-1 and will be in reference to the pregnancy and not to the child.

A further important distinction to make is between 'fertility intentions' and 'pregnancy intention'. My focus in this thesis is on pregnancy intention. By this I mean women's feelings, thoughts and plans about their current or recent pregnancy. Fertility intentions, on the other hand, is a demographic concept referring to how many children a woman would like to have in total and therefore requires women to consider their whole reproductive lifespan. Since the measurement of pregnancy intention developed from the measurement of fertility intentions, and there is much that can be learned from this literature, I do talk about both, however I have taken care to use the terms according to these definitions.

2.2.2 The measurement of pregnancy intention in the 1900s – 1950s

According to Campbell and Mosher (2000), concern about the falling birth rate and its implications for population growth in the early 20th Century triggered the first investigations into fertility intentions (41). At that time 'differential fertility' was a popular hypothesis. This proposed that the harshness of life for the poor led to higher fertility (through psychological reactions), whereas wealth led to lower fertility (42). According to Pearl, what this hypothesis failed to consider was that the higher rates of fertility in the poor could be because of unintended pregnancies due to a lack of access to family planning services (43). Early research was therefore driven by an interest in contraceptive use and family building patterns.

The first systematic attempt to investigate the factors associated with fertility was the 'Indianapolis Study', albeit in a highly restricted sample of fecund couples that were married between 1927 and 1929 while the wife was aged under 30, were white, Protestant, USA born and had education up to eighth grade level (44). Contraceptive histories were used to define pregnancy-planning status. Four groups were devised into which couples were categorised: number and spacing planned (all pregnancies planned), number planned (planned the number of pregnancies but not (all of) the intervals between them), quasi-planned (couples whose planning behaviour suggested unplanned pregnancy but who reported on attitudinal questions wanting that pregnancy) and excess fertility (additional pregnancy(ies) after the last wanted one) (45). Here unwanted childbearing was conceptualised in terms of family size rather than on an individual pregnancy basis. This study found that 28% of couples were 'number and spacing planned', 14% were 'number planned', 31% were quasi-planned and 26% had experienced 'excess fertility', suggesting that 72% of couples had experienced at least one unintended pregnancy (45).

2.2.3 The measurement of pregnancy intention in the 1950s – 1970s

In the post-World War Two era the concern shifted from population decline to population growth and excess fertility, particularly at the end of the reproductive lifespan. The questions developed at this time reflect these

concerns. In the USA the Indianapolis Study's successor was the Growth of American Families (GAF) Study of 1955, which was designed with a new cohort-style fertility measure in mind. It asked white, married woman aged 18-39 how many children they expected to have in total and averaged this to calculate a collective forecast of completed fertility (41). Pregnancy planning status was assessed by a series of questions about contraceptive use and intentions, with separate questions on wantedness. According to this study 13% of pregnancies were unplanned; in the 1960 GAF it was 17% (41). Although the GAF did not interview the partner, it was an improvement on the Indianapolis Study in that a more representative sample was chosen, particularly in 1960 when non-white women were included. However, they did not capture the issue of pregnancies that were mistimed, i.e. they occurred sooner than intended, partly because they were still thinking about overall fertility not individual pregnancies.

With the introduction of the contraceptive pill in 1960 new questions needed to be asked. The National Fertility Study (NFS) replaced the GAF in 1965 and is the first time that we see the sort of pregnancy intention questions still in use today, shown in Table 2-1. There were two key changes in these assessments. Firstly, instead of considering the couple's overall fertility, attention shifted to the individual birth or pregnancy. Secondly, the distinction between pregnancies that were unwanted at any time and those that were mistimed was introduced. These concepts have remained in wide use ever since.

At about the same time the first attempts to assess unplanned pregnancies in the UK were being conducted, first by Ann Cartwright in 1967-8 (46), then by Margaret Bone in 1970 (47) and again by Cartwright in 1973 (48). Cartwright's questions are shown in Table 2-1, but these were only asked of 'legitimate' births i.e. those born within marriage. Bone asked a mixture of questions about intentions and contraceptive use but, again, only in relation to 'legitimate' births. Cartwright estimated that about a third of pregnancies were unintended in 1967-8 (46) whereas Bone, using stopping contraception

as a marker of planning status, concluded that 54% of pregnancies were unplanned (47).

Survey name	Pregnancy intention questions on survey
National Fertility Survey (NFS) 1965 and 1970. USA.	**1965 questions:** Planning: 1) Under which of these circumstances did this pregnancy occur? a) While using a method and did not want to become pregnant at that time; b) While not using a method but did not want to become pregnant at that time; c) When stopped using a method in order to have a child. Wantedness: 2) Before you became pregnant this time, did you want to have a(nother) child sometime? 3) Did your husband want to have a(nother) child sometime? **1970 questions:** Planning: 1) Did that pregnancy occur because you deliberately stopped using a method in order to have a child, or did it happen even though you did not want to get pregnant at that time? Wantedness: 2) Just before you got pregnant that time, did your husband want a child but not until later, or did he really want no more children? 3) Did you yourself want a child but not until later, or did you really want no more children?
Cartwright, data collected in 1967-8 and 1973. UK	1) Apart from what you feel now - looking back to the time when you found you were pregnant - at the time would you rather it happened a bit later or earlier or were you pleased when you were pregnant then or sorry it happened at all? 2) Around the time that you became pregnant were you and your husband using any method of birth control? **Added in 1973:** 3) So would you say you intended to become pregnant that time or not?

Table 2-1 Pregnancy intention questions used in the National Fertility Study 1965 and 1970 (USA) and the first UK assessment of unplanned pregnancies in 1967

It is a reflection of the times that these surveys relied so heavily on contraceptive use as a marker of pregnancy intention. The paradigm was one of rationality and planning, with the demographic transition[vi] thought to occur as society transitioned from 'traditional' to 'modern' – a society characterised by *'enhanced survival… individualism, rising consumer aspirations… huge and socially mobile urban populations… and [the] decline*

[vi] The transition from high fertility and mortality rates to low fertility and mortality rates.

of fatalistic in favour of conative habits of thought'[vii] (p662) (49). This meant moving towards fertility being within the *'calculus of conscious choice'* (p53) (50) where fertility limitation was both desirable and achievable (51). Under this rationale, pregnancies that occurred when contraceptive attempts were being made would be assumed to be unplanned, hence contraceptive behaviour could be used to define pregnancy planning. At the time, apparent contradictions in women's responses to questions about contraceptive use and the acceptability of the timing of the pregnancy were noted (46, 48, 52), but only in the USA was this voiced as methodological concerns (52, 53).

The 1965 NFS concluded that only 26% of pregnancies were intended in terms of both number and timing (52), a finding that stimulated the Commission on Population Growth and the American Future to recommend *'a national policy and voluntary program to reduce unwanted fertility'* (54). It also recommended that further research be done in this area, leading to the establishment of the National Survey of Family Growth (NSFG).

2.2.4 The measurement of pregnancy intention in the 1970s – 2000s

The first NSFG was conducted in 1973 and since then surveys have been conducted every six or seven years. Due to societal changes, these surveys have been expanded over time to include unmarried women and a wider age range and from 2006 started interviewing men as well as women about pregnancy intention (55). The questions used are shown in Table 2-2.

[vii] Psychology has identified three components of the mind: cognition, affect, and conation. Simply speaking cognition refers to knowledge, affect to feeling and conation is the connection of knowledge and feeling to behaviour. It is the proactive aspect of behaviour, closely associated with the concept of volition. So the shift to '*conative habits of thought'* means a transition towards behaviours enacted deliberately to achieve an intention realised as a consequence of individuals linking knowledge and feeling.

Survey name	Pregnancy intention questions on survey
National Survey of Family Growth (NSFG) from 1973, 1976, 1982, 1988, 1995 2002, 2006-2010 and 2011-2013. USA.	1) Was the reason you (were not/stopped) using any method because you, yourself, wanted to become pregnant? (Yes/No - If yes, go to Q4, If no, go to Q2) 2) At the time you became pregnant, did you, yourself, actually want to have a(nother) baby at some time? (Yes/No/Don't know - If yes, go to Q4, If no, go to Q5, if don't know, go to Q3) 3) It is sometimes difficult to recall these things, but, as you look back to just before that pregnancy began, would you say you probably wanted a(nother) baby at some time or probably not? (If probably yes, go to Q4, if probably no or didn't care, go to Q5) 4) Did you become pregnant sooner than you wanted, later than you wanted, or at about the right time? (Sooner/ later/right time/didn't care) 5) And what about your partner at the time you became pregnant... did he want you to have a(nother) baby at some time? (Yes/no/don't know - If yes, go to Q6) 6) Did you become pregnant sooner than he wanted, later than he wanted, or at about the right time? (Sooner/later/ right time/didn't care) **Additional questions used in 1995 survey**: (For all women) Which number on the card best describes how you felt when you found out you were pregnant? (Card has a 10-point scale from 1 – very unhappy to 10 – very happy) (For women under 25) Which number on the card best describes your opinion about becoming pregnant? (Card has a 10-point scale from 1 strongly disagree to 10 – strongly agree) You were worried that you did not know enough about how to take care of a baby; You thought that a new baby would keep you from doing the things that you were used to doing like working, going to school, going out and so on; You looked forward to teaching and caring for a new baby; You looked forward to the new experiences that having a baby would bring; You looked forward to experiencing the changes in your body that come with carrying a baby; You looked forward to telling your friends that you were pregnant; You were worried about what being pregnant would do to your body; You were worried that you did not have enough money to take care of a baby; You dreaded telling your friends that you were pregnant; You looked forward to buying things for a new baby.

Table 2-2 NSFG pregnancy intention questions

Additional questions were added in 1995 (shown in Table 2-2) in response to concerns raised in the 1988 data about misinterpretation by respondents of the wantedness questions and in recognition of the potential importance of ambivalence as a response option (36). One question was only asked of women aged 15-24 and was aimed at assessing the degree of ambivalence towards the pregnancy. The other question, asked of all women, assessed

how happy or unhappy they were on discovering that they were pregnant. Some associations between this measure of happiness and the usual categories of pregnancy intention were shown (56). While some preferred the fact that the happiness scale was continuous (57), Trussell and colleagues showed that there were considerable inconsistencies between intention, happiness and contraceptive use in these data (58). These findings are described further in section 2.2.5.1.

In addition to the NSFG, the Pregnancy Risk Assessment Monitoring System (PRAMS) has been collecting state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after pregnancy since the late 1980s. The question used is shown in Table 2-3.

Survey name	Pregnancy intention questions on survey
Pregnancy Risk Assessment Monitoring System (PRAMS) from 1987 to date. USA	1) Thinking back to just before you were pregnant, how did you feel about becoming pregnant? a) I wanted to be pregnant sooner b) I wanted to be pregnant then c) I wanted to be pregnant later d) I didn't want to be pregnant then or at any time in the future.

Table 2-3 PRAMS pregnancy intention questions

Despite the increasing availability of contraception, the NSFG and PRAMS studies showed that unintended pregnancies were increasing over time. They also demonstrated that unintended pregnancies were not confined to adolescents (41). As a consequence, the Institute of Medicine convened a Committee on Unintended Pregnancy who compiled a report emphasising the policy and programme implications of unintended pregnancies (37).

There have been several other large cross-sectional and/or long running cohort studies conducted in the USA over the last 50 years. The questions from these studies are included in Appendix D. In the UK several further studies were conducted in the late 1970s and 1980s (48, 59-61). Their questions are shown in Table 2-4. Cartwright's 1988 survey classified 27% of live births as unintended (59) and Fleissig's as 31% in 1991 (60). These findings were contested by a small study that found higher rates when all pregnancies were considered instead of live births only (62). These were the

last available national estimates of unintended pregnancy for England and Wales until the most recent National Survey of Sexual Attitudes and Lifestyles data were published in 2013 (63). This found that 54·8% of pregnancies were planned.

Study name	Pregnancy intention questions on survey
Cartwright, 1976 Cartwright, 1988 Fleissig, 1991	1) When you first found out you were pregnant, how did you feel about it then? - Would you rather it had happened a bit later or were you pleased you were pregnant then, or sorry it had happened at all? 2) Around the time you became pregnant were you or your husband or partner generally using a method of birth control? (Yes/No) 3) So would you say you intended to become pregnant that time or not? Answer to question 3 defines unintended/unplanned
Dunnell, 1979	When you became pregnant that time would you say you were trying to get pregnant or not trying to get pregnant? If not, Would you say then it was a complete accident, a kind of accident on purpose, or did you just not mind if you got pregnant?

Table 2-4 Questions used in UK studies of pregnancy intention in the 1970s and 1980s

Internationally the most common measure of pregnancy intention is that used in the Demographic and Health Surveys (DHS). This uses a single question, shown in Box 2-2, to categorise pregnancies occurring in the last five years and ending in a live birth as intended, mistimed or unwanted.

> At the time you became pregnant did you want to become pregnant then, did you want to wait until later, or did you want to have no (more) children at all?

Box 2-2 DHS pregnancy intention question

Given that the DHS is a survey organised by the USA it is perhaps not surprising that there is such similarity between the framing of the question and the categorisation of pregnancies in the DHS and those that we have seen used in the USA over the last 50 years.

As can be seen from the tables in this section, questions about pregnancy intention rarely directly ask about 'intention'. Instead these questions ask about a range of dimensions – contraception use, whether she wanted a child or pregnancy, the timing of the pregnancy, her partner's intentions and

her feelings about becoming pregnant – but in different ways and in different combinations. Despite this they use the responses to these different questions to categorise pregnancies in the same way, i.e. as 'intended' or 'unintended'. This suggests that there is a lack of clarity about the concept being measured (9).

2.2.5 The concept of pregnancy intention and its theoretical basis

Pregnancy intention might initially seem to be a self-evident, straightforward and unproblematic concept but efforts to measure it over the last century have shown that it is not.

As we have seen in the design of the questions, pregnancy intention was initially thought of as a uni-dimensional concept. Pregnancies were either intended or unintended and this was originally determined on the basis of contraceptive use. This stance was supported by Kristen Luker (64) who *'placed women's sexual behaviour and… family planning in the USA squarely in the realm of rational choice'* (p378) (65). Consequently the understanding and measurement of pregnancy intention was originally grounded in intentionality-based behavioural models, such as the Theory of Reasoned Action (66) and, subsequently, the Theory of Planned Behaviour (67).

2.2.5.1 Intentionality-based behavioural models of pregnancy intention and the role of contraceptive use

The Theory of Reasoned Action was the first to place the individual within a broader social context through the inclusion of their normative beliefs; something that its predecessors, cognition models such as the Health Belief Model, had been criticised for omitting (68). The Theory of Reasoned Action was subsequently developed into the Theory of Planned Behaviour (TPB), which conceptualised intentions as *'plans of action in pursuit of behavioural goals'* (p456) (69). The TPB sees intentions as the outcome of a combination of attitudes towards the behaviour, subjective norms and perceived behavioural control – distinguishable aspects leading to intentions and then to behaviour (70), as shown in Figure 2-1. Measures grounded in these theories assume that women hold these beliefs, can articulate them,

calculate the costs and benefits of pursing specific actions and then act accordingly (71). On this basis some have gone as far as to say that pregnancy intentions are the most immediate determinant of fertility and fertility-related behaviours (72).

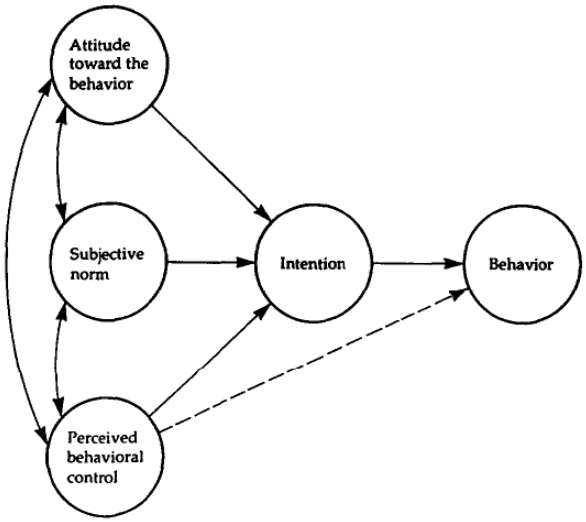

Figure 2-1 Diagrammatic representation of the Theory of Planned Behaviour (73).
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While these theories have been useful in developing our understanding of pregnancy intention, critiquing them can yield further insight into the concept of pregnancy intention. The TPB would predict no, or minimal, discrepancies between a formed intention to avoid pregnancy and contraceptive use. However, there are ample data to refute this (46-48, 53, 58, 74-78). As mentioned in section 2.2.4, Trussell and colleagues used data from the NSFG 1995 survey to compare contraceptive use, pregnancy intention and happiness about pregnancy. They showed that only 68% of pregnancies conceived whilst the woman was using contraception (which would all be expected to be unintended by the researcher / TPB) were classified as unintended by the woman. Where pregnancies conceived as a result of contraceptive failure were classified as intended, 90% of women described being ‘happy’ or ‘very happy’ about the pregnancy, compared to 25% of those whose pregnancies were classified as unintended (58). These data show that the relationship between the affective measure of happiness and the measure of intention is stronger than the relationship between intention

and the behavioural aspect of contraceptive use. Consequently questions that measure pregnancy intention on the basis on contraceptive use will give different estimates to those that ask about timing or happiness at being pregnant.

The relationship between intention and contraception is clearly not as strong or straightforward as theories such as TPB propose. As suggested by the TPB it may be a perceived lack of behavioural control that means that women do not carry out their reproductive intentions. This may explain the weak relationship between pregnancy intention and contraceptive behaviour. However, other research has suggested that behaviours may be habitual and therefore not subject to such rationalisation or they may reflect other, underlying intentions (79, 80). For example, ethnographic research in the USA has shown that people *'sometimes had more immediately salient goals than averting pregnancy, even in the absence of pregnancy intention'* (p135) (81). For some the risk of pregnancy enhanced their sexual pleasure, while others romanticised the idea of creating a child with their partner during sex, without actually intending to do so (81). These psychological benefits of sexual risk taking have generally been omitted from the public health and family planning literature.

Esacove further explored this in her investigation of women's sexual behaviour using narrative theory (65). She found that, when women recounted their reproductive life histories, sex was rarely about reproduction. Instead it was seen as a rite of passage, a way to maintain or define a relationship or something that contributed to a sense of self-worth and was a way to share intimacy and love, as well as being an act of pleasure. Miller and colleagues have also highlighted that the motivations to engage in sexual activity can be distinct from the motivation to have children (82). As Esacove says, this is in contrast to *'family planning efforts, which locate the (potential) reproductive aspects of sex as the central component of each sexual encounter'* (p384) (65).

There are several other potential explanations for the disconnect between intentions and behaviours. Self-reported contraceptive use and actual

contraceptive use may not be the same; a woman may report that she was using contraception but in fact missed one or more pills or was overdue her injection (7, 79). Contraception must be used consistently and correctly in order for it to be effective. Failure to do so may reflect ambivalence on the part of the woman about becoming pregnant (83, 84), partner influences, a less than positive attitude to contraception (78, 85) or a lack of awareness of the risk of pregnancy. For example, in an HIV prevention programme the majority of women reported that they had not considered the possibility of pregnancy at the time they last conceived (86).

2.2.5.2 Development of the components of pregnancy intention

The weak relationship between pregnancy intention and contraceptive use does not mean that contraceptive use is not relevant in terms of assessing pregnancy intention. However, it should be seen as a component of pregnancy intention, not as a proxy for it. Other important components have been described, for example in the 1970s Miller drew a distinction between 'intention' and 'want' (87), though confusingly these do not correlate with the definitions in Box 2-1. He described 'intention' as referring to a woman's desire for conception whereas 'wantedness' related to her feelings about the pregnancy after conception. This was based on his findings that while almost all intended conceptions led to wanted pregnancies, 15% of unintended conceptions led to pregnancies described as wanted (87). This ability to translate an unintended conception into a wanted pregnancy was due to what he described as a 'wantedness reserve'. These findings are consistent with those of the Indianapolis Study (44) and with inconsistencies seen between contraceptive use, happiness and pregnancy intention noted by Trussell and colleagues (58).

Over time, the understanding of the components of pregnancy intention has developed further. Stanford et al. identified five distinct dimensions of pregnancy intention in their qualitative work with pregnant women, shown in Box 2-3 (13). Many of these components are the same as those found by Speizer et al.'s qualitative work in New Orleans (12). Likewise Santelli et al. found pregnancy intention to be multi-dimensional (11). Their quantitative

analysis of data collected in the 2002 NSFG found that continuation or termination of pregnancy was predicted by 'desire' and 'mistiming' which were calculated on the basis of women's responses to questions about happiness at becoming pregnant, planning or trying to become pregnant, wanting a baby with a specific partner, her partner's intention and saying that the pregnancy was 'on time'.

1. Pre-conception desire for pregnancy. This arises from a complex interaction between long-term goals and values for marriage, family, education and career based on the woman, her partner, her family and wider relations' attitudes and experiences.
2. Steps taken to prepare for pregnancy. This included discussion with others, marriage and pre-conception changes to personal health.
3. Fertility behaviours and expectations, which were mostly related to contraception behaviours such as use or discontinuation.
4. Post-conception desire for pregnancy, which was associated with the same factors as pre-conception desire but reinterpreted in the light of pregnancy. This is described as an affective response and could be strong enough to transform a lack of desire pre-conception in to a positive post-conception desire, similar to the wantedness reserve described by Miller (87). Conversely a lack of support from a partner could cause the reverse.
5. Adaptation to pregnancy and baby. This last factor related to the decision to continue or abort the pregnancy.

Box 2-3 Stanford et al.'s five dimensions of pregnancy intention (13)

Miller has also described the concept of childbearing desires as being influenced by a complex of value systems, personality traits, childbearing motivations, lifecycle factors (such as approaching the end of the reproductive lifespan) and situational factors (88). Others have noted the important influence of these social factors on intention (5, 10, 39, 89). Many have argued that the focus on individualistic intentionality-based behavioural models ignores the fact that human behaviour, and reproductive behaviour in particular, is culturally determined in multiple ways, some of which women may not explicitly be aware of (65, 90-92).

Furthermore, women and couples may not have explicit fertility intentions (9, 39, 89, 90, 92) or they may be unclear, ill-defined and fluid in response to circumstances (53, 93). Couples may decide not to have a child yet, without definitely deciding whether or not to have another child at some point; a phenomenon described by Timæus and Moultrie as 'postponement' (94). Working in Cameroon, Johnson-Hanks has written extensively about the 'uncertainty' of everyday life due to political instability and rapid economic reversals (93, 95, 96). She argues that in such a context it is not possible to plan action on the basis of intentions and posits instead that women do not have an plan in mind but act on the basis of 'judicious opportunism' (93).

On the basis of focus groups with couples in Italy, Mazzuro and Ongero surmised that, according to participants, the costs of having a child outweighed the benefits such that: *"if one were to truly evaluate the consequences of the decision to become a parent, nobody would ever have children"* (97) (cited in (98)). Rather than make this decision, these couples' pregnancies, particularly first pregnancies, were described as occurring as a result of 'suspended rationality' or a course of non-decision (98). Similarly Fisher talks about non-decisions and 'tacit understanding' between couples in her qualitative interviews with couples in the UK (90).

These factors make it difficult for respondents to give a simple yes/no type answer to questions about whether or not they want(ed) more children.

2.2.5.3 Development of a social-cognition theory of pregnancy intentions

Alternate theoretical perspectives to the intentionality-based models have been put forward. These draw on the anthropological and social psychology literature, empirical work on the relationships between fertility behaviours and intentions and also incorporate broader social influences more explicitly (65, 93).

Bachrach and Morgan in particular have challenged the assumption that conscious intentions precede all behaviours and have developed a 'cognitive-social model of fertility intentions' (99). In this they have drawn on insights from neuroscience and cognitive science as well as social theories

relating to environmental structures and social institutions. Their model is shown in Figure 2-2.

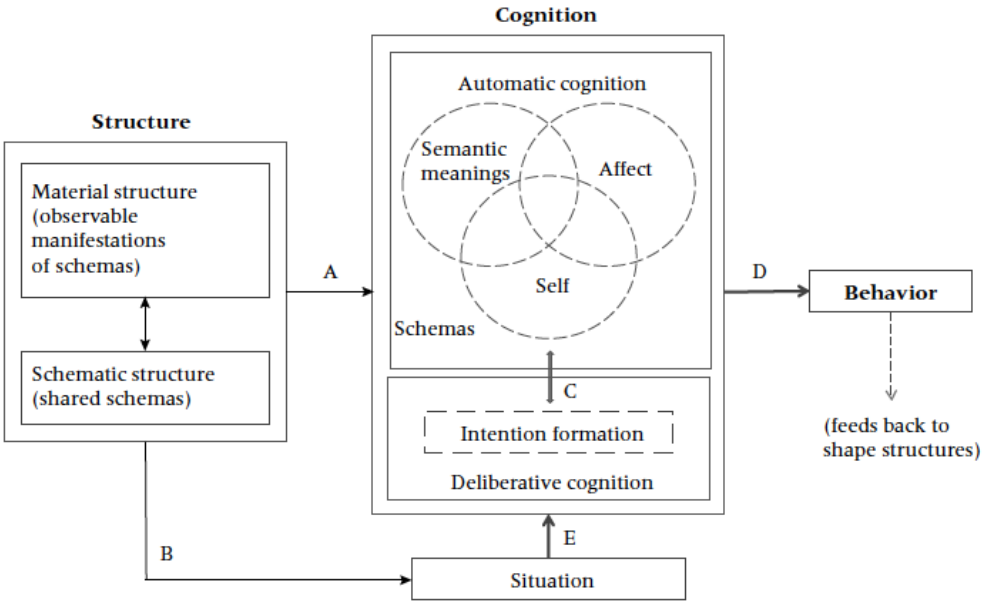

Figure 2-2 Bachrach and Morgan's cognitive social model of intentions (99)

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Although complex, this model attempts to bring together and explain more clearly the multiple forces that determine an intention and whether that intention is acted upon. As they explain, *'schemas can represent concepts (e.g. the concept of a family) or actions appropriate to particular contexts (e.g. using a condom with a new partner)*' (p461) (99). Schemas *'are grounded in representations of the sensory, somatic and affective states'* (p462) (99) and are learned through interaction with our environment, which is both social and socially structured. These schemas characterise the self, what and who we are in relation to the world, and therefore have a motivational force. 'Structures' are durable forms of organisation, patterns of behaviour or systems of social relations, though they vary by time and place (100). They may be material (essentially observable e.g. behaviours or environments) or schematic (e.g. values, beliefs and norms) and are interdependent. Examples of structures would be the norm in modern societies of the two-child family or the differing options available to Catholic and non-Catholic women experiencing an unintended pregnancy (99).

Specifically in relation to pregnancy intention they say the following:

> *'..a woman forming an intention to become a mother would usually have formed a schema of parenthood associated with a positive affect. She would also have a mental script for becoming a mother: a set of schemas that linked particular actions to conceiving and bearing a child. Having a desire for the outcome implies that the relevant schemas are not only positively valued, but also linked to the self in some way, perhaps as part of an image of a potential future self.'* (p466) (99)

Therefore pregnancy intentions are formed when the schema for an outcome and the schemas for achieving that outcome are both tied to the image of the self, thereby motivating action. This requires negotiation with potentially competing schema related to, for example, education, career and relationships. This can be used to explain Luker's assertion that pregnancy intentions are currently more about the decision to enter the social role of a mother (a schema in this model) and that changes in the broader social determinants of fertility, such as marriage, (structures in this model) complicate this decision further (38).

Contrary to the theory underpinning the intentionality-based models, Pathway D in Figure 2-2 shows that behaviour can occur without having consciously formed an intention. This could be because that behaviour is taken on the basis of achieving a different intention. For example, sex (an action associated with structures related to relationships) is necessary for reproduction (an action associated with structures related to family and parenthood) but is not only engaged in for reproductive purposes, as we saw in section 2.2.5.1. Bachrach and Morgan conclude that *'there are many unintended pregnancies because there are many situations in which the dominant schemas and material structures are "not about" fertility'* (p478-9) (99).

Some intentions may be formed in response to a situation, rather than in advance of it (pathway E), as per Johnson-Hanks' idea of 'judicious

opportunism' (93). Searle describes these as 'intentions in action' as opposed to the 'prior intentions' discussed thus far (101). It is possible that the situation of being asked about your fertility intentions in a survey is when you form them, making them 'intentions in action'. This would contribute to their instability and weakness, at the level of the individual, in accurately predicting future fertility.

The development of theory in this area has shown us that pregnancy intention is not a uni-dimensional concept. It is socially constructed, therefore has and will continue to change over time as social structures change. For an individual woman it is informed by the values, opinions and attitudes held in her social network: her partner, family, friends and community, which may or may not represent those of wider society. A woman's emotional response to pregnancy will be influenced by her current situation and life goals, such as education, marital status and career aspirations, as well as her economic stability and the support of her partner. There are behavioural components to pregnancy intention, such as contraceptive use and seeking pre-conception care, but as humans are not entirely rational and there are multiple, often conflicting, forces in action behaviours often do not strongly correlate with the other components of pregnancy intention.

2.3 Critiques of measures of pregnancy intention

As we have seen, pregnancy intentions are *'the product of multiple, complex, interwoven social and economic forces'* (p89) (11) making them a *'complex concept … encompassing affective, cognitive, cultural and contextual dimensions'* (p94) (5). This has presented many challenges for assessment and it is often in the recognition of the limitations of the measures that progress in understanding the concept and improving its assessment have been made. It is in that spirit that I critique these measures.

2.3.1 Implications of the timing of assessment

Attempts to measure pregnancy intention are trying to capture a woman's intentions before she became pregnant. They are therefore almost always

retrospective, at best asking the woman while she is pregnant but usually asking her at some point after the birth. This introduces the possibility of recall bias given the time that has elapsed between the period of interest (pre-conception) and the time of the assessment (up to five years after birth). In addition, there is a significant potential for ex-post rationalisation (102). This could be because women may be reluctant to be seen to be describing their child as having been unwanted (in the conventional sense of the word) due to social desirability bias, even though the researcher is technically asking about the conception, not the resulting child. Alternatively women may have adapted to having the child, as per Miller's wantedness reserve, or her response may reflect her current attitude to the child, which could be informed by the child's characteristics (102). In addition pregnancies with better outcomes are more likely to be reported as intended (102). If this is the case then assessments based on retrospective measures are likely to overestimate intended pregnancies. The misclassification caused may obscure the relationship between contraceptive use and reported intention as well as any relationship between pregnancy intention and pregnancy outcome.

Several studies have tried to investigate this phenomenon. Three studies in the USA and one in India compared prospective and retrospective reports of pregnancy intention. They all noted that pregnancies that were prospectively classed as unintended tended to shift to be reported as more intended retrospectively (6, 103-105). Poole et al. compared intentions in the second and third trimesters of pregnancy in the USA and found that even within pregnancy about a fifth of women changed their reported intention, with more women moving from unintended to intended than vice versa (106). Comparison of two waves of the DHS in Morocco, comparing retrospectively reported intention for the same birth three years apart, found that of all the births that had been described as unwanted in the first wave, only 38% were still described as unwanted in the second wave. This means that 62% of births reported as unwanted in the first wave had been reclassified as either mistimed or intended; only 16% moved in the other direction (33). However, a more recent study in the USA compared reported intentions for the same

births about six years apart and found that slightly more women moved from intended to unintended (12%) than moved the other way (10%) (107).

This suggests that in order to obtain the most accurate assessment of pregnancy intention it should be measured at the point of interest, i.e. before conception. This is known as 'prospective pregnancy intention'. Given the fluidity of pregnancy intention over time and in response to other life events, such as a change in relationship status, prospective pregnancy intention would have to be measured frequently in order to ensure that the last recorded intention prior to pregnancy is up to date. This may result in a Hawthorne effect, whereby women's response changes because they are being asked about it frequently (108). Furthermore, prospective measures may still suffer from social desirability bias as women may not want to disclose that they want a number of children that is different to the social norm in that setting. Given the frequency of measurement required, using such a measure as part of routine surveillance for estimating the prevalence of unintended pregnancy would seem to be impossible. This can and has been done in a research setting, though it is certainly challenging and is hampered by the lack of a validated measure of prospective pregnancy intention.

In Malawi, Yeatman and Sennott used panel data on 1,062 women aged 15-24 who were interviewed at four-monthly intervals between 2009 and 2011 and in whom there were 590 conceptions (109). They compared seven different ways of measuring pregnancy intention that were a mixture of prospective and retrospective measures. They found that retrospective measures did indeed tend to overestimate levels of intended pregnancy. They also found that prospective measures tended to underestimate intended pregnancies, despite what would be considered very regular pre-pregnancy assessment. This was because the young women in this study frequently changed their reported ideal family size and desired timing of next child and because more conceptions occurred after women changed their intentions to wanting more than vice versa.

At aggregate level there were no statistically significant differences between the measures, even between the 'worst' – the retrospective post-birth assessment – and the 'best' – a time varying prospective measure. The highest levels of agreement were seen between the last prospective measurement taken before conception and the first retrospective measure during pregnancy. Assessment during pregnancy would be more feasible for routine surveillance than the 'ideal' prospective measure as it could be done during antenatal care. It would also yield less biased estimates than the current retrospective post-birth assessments, though assessment in pregnancy is still a retrospective measure and is therefore subject to some recall and rationalisation biases. Where the ideal pre-pregnancy assessments are not possible these data suggest that the assessment of intention during pregnancy is almost as good.

2.3.2 Omission of partner's intentions

Another critique is that it takes two people to make a pregnancy, yet surveys almost exclusively ask women about their intentions. There is some logic to this, since it is the woman who is pregnant and there are often difficulties in asking the partner. However, the partner plays an important role (11-13) and we can at least ask the woman's perspective on her partner's intention as a reasonable proxy. Married women have generally been found to report their husband's intentions accurately, unmarried women less so as discussion and agreement may be less common or different with partners than with husbands (110-112).

2.3.3 Omission of pregnancies ending in abortion

Given that they are retrospective, most studies tend to only ask about births, or even just live births. This means that pregnancies ending in abortion are omitted yet many of these will have been unintended. In low-resource settings abortions are often unsafe and contribute significantly to maternal mortality and morbidity, so these unintended pregnancies can have particularly severe consequences. This means that both the prevalence of unintended pregnancy and their consequences are underestimated using the current methodology.

2.3.4 Use of a single question to determine and dichotomise intention

Some surveys now use a combination of questions but many, like the DHS, still categorise pregnancies as intended or unintended on the basis of a single question. Given the complexities of the concept of pregnancy intention this method of assessment would seem to be a gross over-simplification. No single question can address the multi-dimensional nature of pregnancy intention or reflect the complexity of identifying a pregnancy as wanted (10). This may explain some of the discrepancies seen between studies using different measures of intention.

For example, at an individual level, Kaufmann et al. showed that 25% of responses given to two different sets of questions about pregnancy intention (NSFG and DHS questions) in the same survey were discordant (113). Overall, the percentages of pregnancies that were intended, mistimed and unwanted were the same with either set of questions. Most discordant responses involved pregnancies that were reported as mistimed on one set of questions but not on the other, and discordancy was more common among younger, unmarried women of lower socio-economic status and education level.

As mentioned in section 2.2.5.2, concerns have been raised that women, particularly younger women, may not have decided, or even considered, whether or not they wanted a(nother) child (36, 53, 113). These women may therefore not be able to further classify their unintended pregnancy as mistimed or unwanted. In the absence of well-defined fertility intentions they may form 'intentions in action' i.e. in response to being asked about them, which may be more unstable. Furthermore, the questions may not allow them to express ambivalence about their pregnancy, so they fall on different sides of the dividing line between mistimed and unwanted when asked slightly different questions, leading to the discordance seen in Kaufmann et al.'s study.

Kaufmann et al. thought that the discordancy was not due to the order of the questions or their different wording but to the fact that asking intendedness questions twice led to an *'increased familiarity with the underlying concepts*

of wantedness and timing [which] affected survey results' (p815) (113). They concluded that discordant responses might be because respondents do not initially completely understand the questions and hypothesised that explaining what unwanted and mistimed pregnancies are before asking the questions may improve the validity of results.

Even where more than one question is asked, or where mistimed or ambivalent responses are possible, the answers are usually combined to dichotomise pregnancies into intended or unintended for analysis. This ignores the fact that there are systematic differences in the women who experience the different types of unintended pregnancies. Within the accepted definitions (see Box 2-1), unwanted pregnancies are more likely to occur at the end of the childbearing period, whereas mistimed pregnancies generally occur in younger women who have not yet completed their education or are unmarried. These different types of unintended pregnancies may elicit very different affective and behavioural responses because, as per the Luker quote in section 2.2.1, there is a fundamental difference between having a third child when you already have two and becoming a mother for the first time (38). Where studies have looked at mistimed and unwanted pregnancies separately they do see differences in both the determinants and consequences e.g. (114-125), signifying the need for a more refined classification of pregnancy intention.

Dichotomisation is likely to lead to the misclassification of pregnancies as it fails to recognise that women may have conflicting or ambivalent feelings towards their pregnancy or that there are important differences between different types of unintended pregnancy. This has consequences for the analysis of the implications of unintended pregnancies and subsequent policy conclusions. It no longer seems justifiable to argue that intended and unintended pregnancies are emic categories into which pregnancies can easily and simply be grouped by women. That is to say that they are not a significant part of how women view their own pregnancies (9). This had led to calls for pregnancy intention to be seen as a continuum.

2.3.5 How measures of pregnancy intention can be improved

Whilst these measures have provided useful information so far, there has been increasing recognition of their limitations and of the need to develop a more sophisticated method for measuring this complex construct (5, 7-13). Petersen and Moos' 1997 review of measures of pregnancy intention reached two main conclusions (10). Firstly, a consistent definition of pregnancy intention, which takes into account the complexity of the issue, must be developed and used. This does not seem to have happened yet. Secondly, a valid and reliable scale of pregnancy intention, from the mother's perspective, is required.

2.4 Development of the London Measure of Unplanned Pregnancy

In 1998 Dr Barrett and colleagues started work on a three-year study to develop a new measure of pregnancy intention in Great Britain. Using interviews to explore women's pregnancy circumstances, as well as women's understanding of the terms commonly used by researchers in this area, they developed the conceptual model of pregnancy intention shown in Figure 2-3.

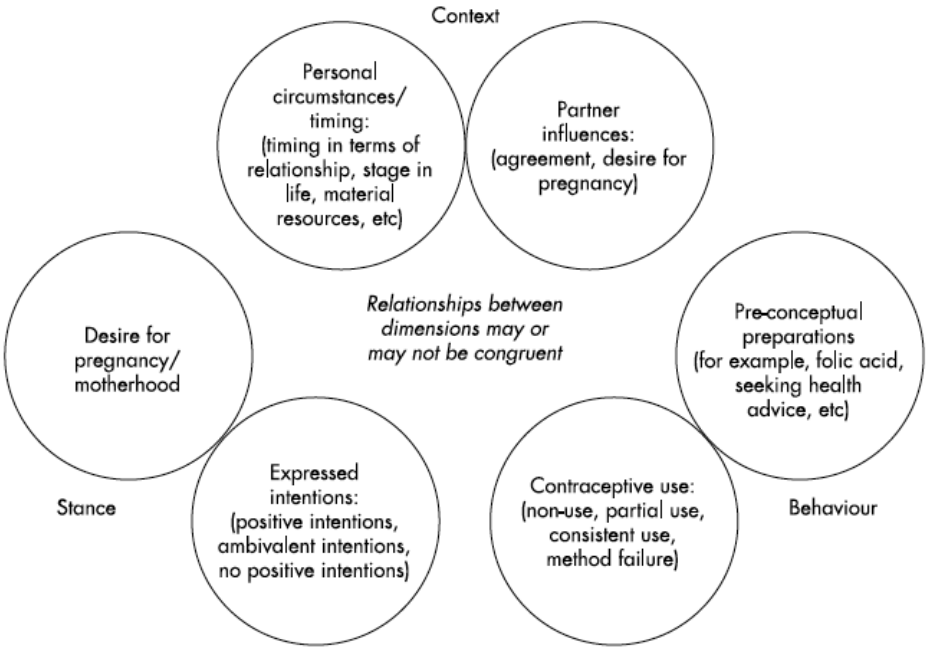

Figure 2-3 The conceptual model of pregnancy intention developed by Barrett et al. (8)
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This conceptual model was used to develop a new tool for measuring the degree of pregnancy intention of a current or recent pregnancy, the London Measure of Unplanned Pregnancy (LMUP). This was rigorously field-tested and evaluated and was shown to be psychometrically valid and acceptable to women (8). The extensive background qualitative work to describe the concept of pregnancy intention and develop the LMUP and its psychometric validation make the LMUP a more theoretically robust measure of pregnancy intention than previous measures.

The LMUP asks six questions as shown in Box 2-4.

1) In the month that I became pregnant...
• I/we were not using contraception
• I/we were using contraception, but not on every occasion
• I/we always used contraception, but knew that the method had failed at least once
• I/we always used contraception

2) In terms of becoming a mother *(first time or again)*, I feel that my pregnancy happened at the...
• Right time
• OK, but not quite right time
• Wrong time

3) Just before I became pregnant...
• I intended to get pregnant
• My intentions kept changing
• I did not intend to get pregnant

4) Just before I became pregnant...
• I wanted to have a baby
• I had mixed feelings about having a baby
• I did not want to have a baby

5) Before I became pregnant...
• My partner and I had agreed that we would like me to be pregnant
• My partner and I had discussed having children together, but hadn't agreed for me to get pregnant
• We never discussed having children together

6) Before you became pregnant, did you do anything to improve your health in preparation for pregnancy?
• Took folic acid
• Stopped or cut down smoking
• Stopped or cut down drinking alcohol
• Ate more healthily
• Sought medical/health advice
• Took some other action
• I did not do any of the above before my pregnancy

Box 2-4 LMUP questions

Each question is scored zero, one or two and these are summed to give a total score between zero and 12 with each increase in the score representing an increase in the degree of pregnancy intention (8). The LMUP has the potential to be a useful tool for understanding pregnancy intention in a range of settings. It has already been translated and validated in India and the USA (71, 126) with other validations in progress.

The LMUP represents a significant advance in the measurement of pregnancy intention as it addresses its multi-dimensional nature by including behavioural, attitudinal and contextual dimensions. Many of the components of pregnancy intention identified in other research are covered by the LMUP (7, 11-13). It is also more in line with the current cognitive-social theory of pregnancy intentions than earlier questions that were based on the intentionality-based models. The fact that women can give conflicting answers across the dimensions of pregnancy intention means that the LMUP does not assume that intentions and behaviours are consistent, avoiding the assumption that individuals are universally rational in decisions related to their fertility. This has been thought to be a feature of 'modern' societies (those that have gone through the demographic transition), as described in section 2.2.3. Models and measures based on this assumption may have limited applicability beyond these 'modern' settings; as the LMUP is not limited by this assumption it may have wider applicability. The LMUP also allows for the fact that behaviours may be expressions of intentions other than pregnancy intentions, which we saw in section 2.2.5.1 may be the case for sex.

Furthermore, the LMUP does not assume that women have clearly defined intentions that allow their pregnancies to be dichotomised into intended or unintended. Instead they are scored along a range of intention from zero (unplanned) to 12 (highly planned), enabling the expression of ambivalence. Cut-points have been suggested to divide the LMUP scores into categories of 'unplanned' (0-3), 'ambivalent' (4-9) and 'planned' (10-12) for estimating the prevalence of unintended pregnancy; pregnancies scoring below 10 would be classified as unplanned (8). However, using the LMUP's full range

for analysis provides *'a more complex and realistic portrayal of human fertility behaviour than existing questions'* (p432) (8).

2.5 Measurement of pregnancy intention in this research

For this research, an accurate assessment of pregnancy intention is vital in order to explore the impact of pregnancy intention on key maternal and neonatal health outcomes. I have shown in this Chapter that measures of pregnancy intention that fail to take account of the multiple dimensions of the concept, that assess pregnancy intention after birth or that dichotomise pregnancies can lead to misclassification. Whether or not this is of importance depends on why you are measuring pregnancy intention.

Population level estimates of the prevalence of unintended pregnancy are roughly consistent over time despite changes on the individual level (6, 33, 103). Therefore, if population level estimates are required, cross-sectional retrospective measures may be acceptable.

However, my interest in this research is at the level of the individual, describing the risk factors for unintended pregnancy and consequences for women and their children of having an unintended pregnancy. If the differences in reported intention at the level of the individual are systematic, not random, then the misclassification is important as it may obscure any relationship between pregnancy intention and pregnancy outcome, if indeed one does exist.

Therefore, I decided to use the psychometrically validated measure, the LMUP, to measure the degree of pregnancy intention. Furthermore, I decided to recruit women and interview them during pregnancy to reduce the risk of recall bias or of the outcome of the pregnancy influencing the reported intention.

2.6 Chapter summary

In this Chapter I have defined the terms relating to pregnancy intention used throughout this thesis and described the development of the theory, concept and measurement of pregnancy intention over the last 100 years. Critiquing

these measures led me to select the London Measure of Unplanned Pregnancy as my measure of pregnancy intention and to assess intention during pregnancy rather than after the birth. The next Chapter presents a review of the literature surrounding the relationships between pregnancy intention and maternal and neonatal health.

Chapter 3 Literature review

This Chapter presents the systematic literature reviews that I conducted for the relationships between pregnancy intention and the primary outcomes of interest: miscarriage, stillbirth, low birthweight, neonatal death and postnatal depression. Meta-analyses were conducted for the primary outcomes where the data permitted. The focus of the literature review was on the primary outcomes, but the literature on the determinants of pregnancy intention and on the relationships of pregnancy intention to other relevant factors, such as antenatal behaviours, is also discussed.

3.1 Introduction

As described in the background section in Chapter 1, the evidence base for the relationships between pregnancy intention and maternal and neonatal outcomes is mixed. There have been three systematic reviews analysing the relationships between pregnancy intention and various maternal and child health outcomes (14, 15, 21). These reviews concluded that scant attention has been paid to investigating the relationships between pregnancy intention, health behaviours and maternal and child health outcomes. The existing research is '*older and methodologically limited'* (p157) (14) and has predominately been conducted in high-income countries. One review found *'persistent gaps in the literature, indicating a need for more studies in developing countries'* (p18) (15).

The most recent review was published in 2011 but was conducted in 2009 and only looked at low birthweight and preterm birth. I therefore conducted my own literature reviews to capture the range of outcomes that I am interested in and to ensure that it was up to date. I first completed the searches in 2012 to inform the sample size calculations and questionnaire design, and I updated them prior to submission in 2015. I conducted and report the literature review and meta-analyses in line with the 'Meta-analysis of Observational Studies in Epidemiology (MOOSE)' guidelines (127).

3.2 Methodology

3.2.1 Search strategy and keywords

I conducted searches for all the primary outcomes on the electronic databases Embase, PubMed and Scopus in March 2015. The postnatal depression search was also conducted on PsychINFO. Previous literature reviews and articles of relevance were used to generate the search keywords. These were refined through exploratory searches. Only English search terms were used. Where possible Medical Subject Headings were used, with search terms modified according to the database. For unintended pregnancy, the exposure, I used stems and words covering the concepts of pregnancy, fertility, birth, child, intention, want, planning or timing and combined these searches using the Boolean operator 'or'. For the outcomes, full and truncated terms, acronyms e.g. LBW for low birthweight, synonyms such as neonatal death and neonatal mortality, and the generic 'pregnancy outcome' were combined with 'or'. One search was conducted to capture all the outcomes rather than each outcome separately as many studies report on multiple outcomes. The results of the separate pregnancy intention and outcome searches were then combined with 'and'. The full Embase search strategy is shown as an example in Appendix E. I did not search for unpublished studies.

3.2.2 Inclusion and exclusion criteria

Since randomised studies are not possible in this area, as women cannot be randomised to have an intended or unintended pregnancy, all the evidence comes from observational studies. Observational studies of any design that investigated the relationship between pregnancy intention and at least one of the outcomes of interest were eligible for inclusion in the review. Studies in restricted populations, such as teenagers or those with particular medical conditions, were excluded, as these were not representative of the general population. Studies had to provide sufficient information on how pregnancy intention was assessed and reported, but no restrictions were placed on the timing or method of the assessment.

For birthweight, studies were included if they reported on low birthweight (defined as less than 2,500g), birthweight in grams, average birthweight or small for gestational age (birthweight below the 10th centile for gestational age). For postnatal depression, publications on the 'baby blues' were excluded as this is a common and transient phenomenon, separate from postnatal depression. Typically these symptoms peak at four to five days after delivery and are resolved by day 10 (128), therefore only studies looking at postnatal depression after two-weeks were included. Studies had to use a validated measure of postnatal depression. Articles published since 1975 and in English, French or Spanish were eligible for inclusion. This was to maximise the chance that research conducted in Central or South America or francophone Africa could be included. I read these papers myself.

Studies that did not address one of the primary outcomes but reported on other outcomes of interest, such as uptake of antenatal care, antenatal depression or breastfeeding, or on the factors associated with pregnancy intention were retained. The findings of these non-systematic reviews are also presented, though the searches were not designed to identify studies addressing the determinants of pregnancy intention or relationships of pregnancy intention to other outcomes and are therefore likely to be incomplete.

3.2.3 Search results

The four database searches looking at all outcomes returned a total of 3,159 hits combined. 945 of these were duplicates, 40 were excluded as they were pre-1975 and 117 on the basis of language. Following review of the title and abstract a further 1,835 of these were removed, mostly because they were not addressing the relationship between pregnancy intention and an outcome of interest.

Of the remaining 222 articles, 84 were relevant to the primary outcomes: eight to miscarriage, stillbirth or neonatal death, 28 to low birthweight and 48 to postnatal depression. The other 138 were relevant to other outcomes or behaviours of interest or to the thesis in general. The full text of the 84

articles was retrieved and reviewed according to the inclusion criteria. The references of these articles were also reviewed to identify any other eligible studies that had not been picked up by the searches. A further 15 potentially relevant studies were identified in this way. The flowchart for the literature review is shown in Figure 3-1.

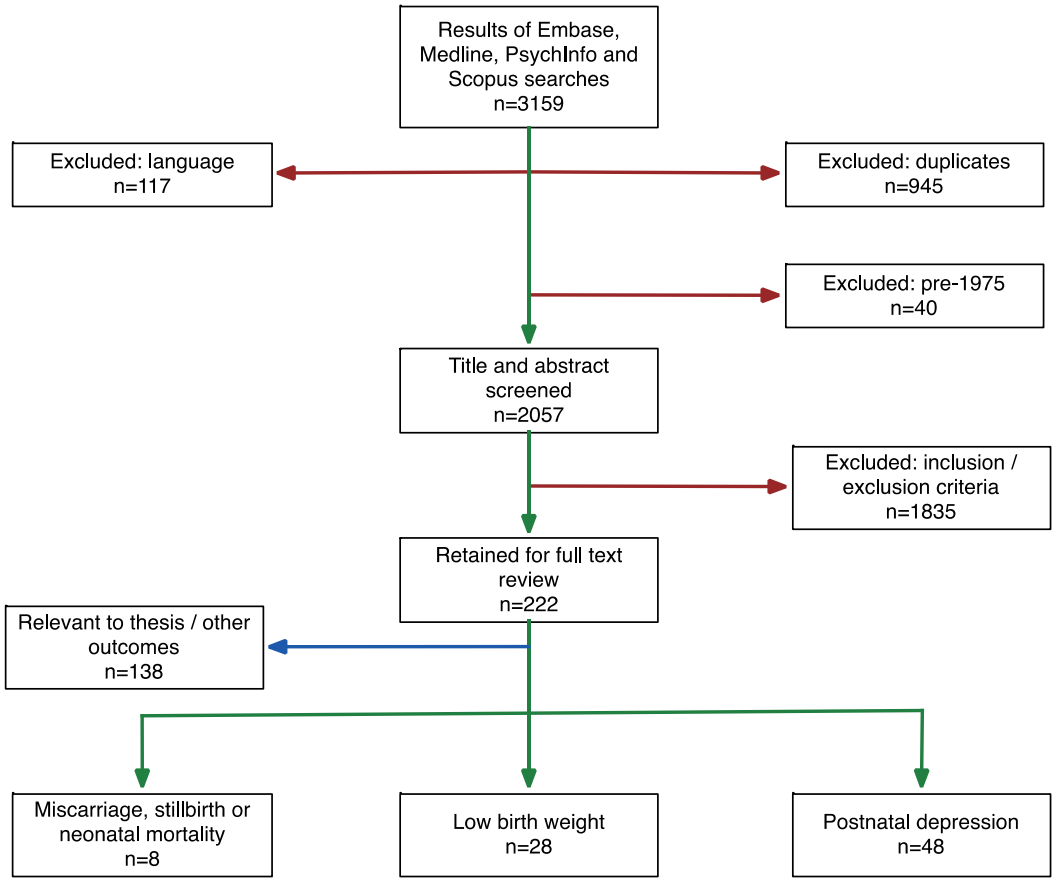


Figure 3-1 Flow chart of selection of studies for the literature review

3.2.4 Quality of study and risk of bias

The potential sources of bias by which the studies were assessed included how the sample was selected, whether the sample was representative, sample size, how the exposure and outcomes were measured (whether they were validated measures and the timing of the assessment), confounders[viii] that were controlled for, loss to follow-up and the type of analysis conducted.

[viii] A confounder is a variable that is associated with both the exposure and the outcome but is not on the causal pathway. Confounders distort the observed association between the exposure and the outcome; failing to control (or adjust) for them leads to biased estimates of effect.

Where appropriate I created funnel plots to investigate publication bias and/or small study effects.

3.2.5 Data extraction

I extracted data from the studies using a template I designed for this review based on the MOOSE guidelines (127). The data I collected included the location, study population, measure and timing of pregnancy intention, proportion of pregnancies classed as unintended (and mistimed or ambivalent if presented), method of assessing the outcome, outcome data and confounders controlled for.

3.2.6 Meta-analysis

Where there were sufficient studies with data available for the primary outcomes, I extracted the raw data from the papers and conducted meta-analyses in Stata to calculate an overall effect size estimate (odds ratio) for the studies. I conducted fixed-effects analyses first and checked the heterogeneity before deciding whether to proceed to a random-effects analysis. Given the expected variety of study populations, study design and assessment method I decided *a priori* that, where possible, I would do sub-analyses by location (using World Bank country classifications) and whether the assessment of pregnancy intention was done during pregnancy or afterwards.

3.3 Results

3.3.1 Pregnancy intention and miscarriage, stillbirth or neonatal death

Eight studies that addressed the relationships between pregnancy intention and miscarriage, stillbirth or neonatal death were identified from the literature review. One was excluded on full text review as it contained no data and an additional study was identified from the references of other papers, giving eight studies in total. The characteristics of these studies are included in Appendix F.

3.3.1.1 Pregnancy intention and miscarriage or stillbirth

There are next to no data on the relationship between pregnancy intention and miscarriage or stillbirth; just two studies in a high-income country (HIC) and one a low-income country (LIC). Dawen et al. found no relationship between unintended pregnancy and miscarriage in women attending an early pregnancy unit in London, UK. Limited information was available on this study, such as how representative the study population was, as it was only available in abstract form (129). Using the London Measure of Unplanned Pregnancy (LMUP) in the UK, Wellings et al. noted that unplanned pregnancies were more likely to end in abortion, but there was no difference in the proportion ending in miscarriage (63).

A study in Ethiopia identified pregnant women in the community, assessed their pregnancy intention and followed them up monthly until the outcome of the pregnancy was known (130). Miscarriage, induced abortion and stillbirth were analysed as a composite of 'pregnancy loss'. Using a robust, prospective methodology they found an adjusted hazard ratio for pregnancy loss of 2.2 (95% confidence interval (95%CI) 1.56, 3.11) for unintended compared to intended pregnancies.

3.3.1.2 Pregnancy intention and neonatal mortality

There have been more studies looking at neonatal mortality in both HICs and LICs. Two studies in the USA found that unintended pregnancies had a greater risk of neonatal mortality (131, 132). Laukaran and van den Berg, working in California with a cohort of ever-married white women with health insurance who were interviewed during pregnancy about their attitude to the pregnancy, found an increased risk of perinatal mortality.[ix] The relative risk (RR) adjusted for parity[x] and husband's occupation was 1.80 (p = 0.003) and adjusted for parity and mother's age was 1.78 (p = 0.002) (132).

[ix] They defined perinatal mortality as deaths from 4 months of pregnancy to 28 days after birth.
[x] Parity is the number of times a woman has given birth.

Bustan and Coker found an adjusted RR of 2.4 (95%CI 1.5, 4.0) for neonatal mortality in married women with health insurance who received early antenatal care but who felt negative about their pregnancies during pregnancy (131). The fact that an increased risk of mortality was found in these two low-risk populations is noteworthy. However, these studies are both old (data were collected in the 1950s and 60s) and their current applicability may be limited given changes in mortality rates and the availability of abortion since these data were collected.

Three studies in LICs looked at neonatal and post-neonatal mortality; two from India and one from Bangladesh. The two studies in India were conducted by the same group but had different methodologies. The first study used nationally representative data from the 2005-6 Indian National Family Health Survey (114). This survey is similar to the Demographic Health Survey (DHS), using the same retrospective question for pregnancy intention, and is therefore subject to the same limitations. They separated unintended pregnancies into mistimed and unwanted (as defined in Box 2-1) to examine differences in outcomes and used sibling controls to match for unobserved heterogeneity at the level of the family. They found increased odds of neonatal mortality and post-neonatal mortality for both unwanted and mistimed births, with a larger effect size and longer duration of effect for unwanted over mistimed births, as shown in Table 3-1.

	Neonatal mortality	**Post-neonatal mortality**	**Deaths from 12-35 months**
Mistimed births	1.82 (1.16, 2.84)	2.06 (1.07, 6.76)	1.37 (0.48, 3.89)
Unwanted births	2.22 (1.17, 4.24)	3.64 (1.39, 9.51)	5.92 (1.48, 23.7)

Table 3-1 Adjusted odds ratios and 95%CI for deaths following mistimed and unwanted births using data from the 2005-6 Indian National Family Health Survey (114)

The other Indian study used prospective fertility intentions recorded in the 1998-99 National Family Health Survey in four states and compared these with the actual fertility of a subset of married women aged 15-39 who were re-interviewed in 2002-3 (115). Using prospective fertility intentions to assume the intention of future pregnancies is different to assessing current

or retrospective pregnancy intentions and does have its own limitations, most importantly that fertility intentions may have changed since the woman was last asked. However, it does remove the possibility of recall bias or that the outcome has influenced the reported intention. This study found higher odds of neonatal mortality (adjusted odds ratio (aOR) 1.83 (95%CI 1.01, 3.34)) and infant mortality (aOR 1.52 (95%CI 0.95, 2.45)) in pregnancies in women who had said they wanted no more children.

A longitudinal study over 20 years in Bangladesh found an increased risk of neonatal (aOR 2.09 ($p<0.001$) and post-neonatal mortality (aOR 2.00 ($p<0.001$)) in children who were unwanted (133). Strengths of this study are that intention was assessed prospectively, in a manner similar to the Indian prospective study, and the analysis used a fixed-effects model to compare wanted and unwanted siblings within families, thereby controlling for unobserved heterogeneity.

3.3.1.3 Pregnancy intention and post-neonatal mortality

Three further studies reported on post-neonatal mortality only, not a primary outcome for this research, but are mentioned for interest. In Thailand, a retrospective cross-sectional survey found that births reported as unwanted by either parent had an increased risk of infant mortality after controlling for socio-demographic factors (aOR 1.15, $p=0.05$) (134). A study of post-neonatal mortality in Bangladesh found no effect of pregnancy intention (135) whereas analysis of five DHS surveys in low- and middle-income countries found mixed effects (136). Using a prospective measure, Montgomery et al. found higher post-neonatal mortality rates in women in Egypt, the Philippines and Thailand who experienced excess fertility but weak or inconsistent effects if the standard retrospective measure of pregnancy intention was used. This highlights the potential for the method and timing of the assessment of intention to influence the findings.

3.3.1.4 Association of mortality with other factors

Since many of the determinants of miscarriage, stillbirth and neonatal mortality are the same as the factors noted to be associated with unintended

pregnancy in section 3.3.4, it is important to be aware of them, and to collect data on them where possible, so that the relationships between pregnancy intention and miscarriage, stillbirth and neonatal mortality can be correctly assessed.

There are a large number of risk factors for miscarriage, not all of which are preventable, for example chromosomal abnormalities in the foetus. The risk of miscarriage is highest in the first trimester, with many conceptions lost before implantation and therefore before the woman is aware of the pregnancy. The known risk factors for miscarriage are listed in Table 3-2 and are drawn from a range of studies (137-144).

Risk factors for miscarriage	
Socio-demographics	Maternal and paternal age, parents not married or living together
Obstetric history	Previous miscarriage, short birth interval,[xi] previous non-medical termination, especially surgical termination, difficulties conceiving e.g. took more than a year
Antenatal factors	High alcohol consumption (drinking every day), poor diet, not taking folic acid / vitamins, maternal stress or anxiety / depression
Other	Low pre-pregnancy weight

Table 3-2 Risk factors for miscarriage

There is an overlap between the risk factors for stillbirth and neonatal death, as it may be mere seconds that separate the categorisation of a death as one or the other; I have therefore considered these deaths together. The known risk factors are listed in Table 3-3 and are drawn from a range of studies (144-157).

[xi] The birth interval is the time since the woman last gave birth.

Risk factors for stillbirth or neonatal death	
Socio-demographics	Maternal age, ethnicity, parents not married or living together, SES (mixed evidence)
Obstetric history	Parity (0 / ≥3), short birth interval (weaker evidence)
Antenatal factors	Lack of antenatal care (esp. tetanus vaccination in LICs), smoking, maternal infections (e.g. malaria, syphilis, gram negative bacteria)
Delivery factors	Obstructed/ prolonged labour, maternal complications in labour, placental abruption, asphyxia
Infant factors	Multiple pregnancy, foetal growth restriction / low birthweight, preterm birth
Postnatal factors	Delayed initiation of breastfeeding
Other	Pre-existing diabetes, hypertension or mental health problems, maternal obesity (HICs) or maternal under-nutrition (LICs)

Table 3-3 Risk factors for stillbirth or neonatal death

3.3.1.5 Summary for pregnancy intention and miscarriage, stillbirth or neonatal death

With such limited data it is impossible to draw any firm conclusions for miscarriage or stillbirth, but the rigorous Ethiopian study suggests that in LICs there may be an increased risk of pregnancy loss in unintended pregnancies. Overall it appears that unintended pregnancies carry a higher risk of neonatal death, both in HICs and LICs. This conclusion is drawn with caution as the data on neonatal mortality from HICs are old and may no longer be relevant. In LICs the fact that several prospective studies have found these relationships, and that they remain after adjusting for a range of known confounders and/or unobserved heterogeneity, lends weight to the argument that this relationship is real and is not an artefact of cross-sectional retrospective methodologies. Whether the same would be true in a HIC using a prospective methodology is worthy of investigation. Furthermore,

these studies have done little to explain *how* pregnancy intention influences the risk of mortality, as they did not consider, for example, antenatal, delivery or postnatal care uptake, meaning this is an area for future research.

3.3.2 Pregnancy intention and low birthweight

3.3.2.1 Findings of the most recent review

Shah et al. conducted a systematic review and meta-analysis of pregnancy intention, low birthweight (LBW) and preterm birth (PTB) in 2009 (21). In the studies they found there was considerable heterogeneity in the assessment of pregnancy intention, in terms of both the question and timing, and almost all studies were conducted in Europe or the USA. On meta-analysis of ten studies they calculated a crude OR of 1.36 (95%CI 1.25, 1.48) for LBW and 1.31 (95%CI 1.09, 1.58) for PTB. The analysis was complicated by the fact that not all studies adjusted for confounders and those that did adjusted for different mixtures of confounders. Consequently the meta-analysis was conducted on unadjusted estimates and may therefore overestimate the relationship.

3.3.2.2 Findings of my review

From my literature search I found 28 studies potentially relating to pregnancy intention and low birthweight after title and abstract screening; a further nine were added from reference searches. The characteristics of these 37 studies are shown in Appendix G.

In brief, 27 of these studies were from HICs (24 from the USA, two from the UK and one from Ireland), two were from LICs (one each from Ethiopia and Benin), two from lower-middle-income countries (LMICs) (one each from Ghana and Egypt), four from upper-middle-income countries (UMICs) (three from Iran and one from Ecuador) and two presented data from several countries. Only seven had assessed intentions during pregnancy, the other 30 asked women any time from shortly after delivery to up to five years after the birth.

The USA studies tended to use either the NSFG or PRAMS questions; the studies in LICs were mostly based on the DHS questions (see Table 2-2, Table 2-3 and Box 2-2 for question wording). Questions about planning or wanting a pregnancy, attitude towards the pregnancy or about the timing of the pregnancy were all considered to be assessing pregnancy intention by these studies. However, these are different dimensions of the concept of pregnancy intention, as I demonstrated in section 2.2.5. Some studies created other measures of happiness (120, 158, 159) and analysed these as well. All studies presented results for intended compared to unintended pregnancies; some also disaggregated the findings for unintended pregnancies into mistimed and unwanted. All but nine of these studies found that unintended pregnancies were associated with low birthweight on crude analysis. Several of these nine negative studies did not present raw data so it was not possible to verify these findings or include them in the meta-analysis.

On full-text review 20 studies were excluded, as shown in Figure 3-2, leaving 17 (59, 116, 117, 120, 121, 158, 160-170) for inclusion in the meta-analysis. Studies that did not present sufficient raw data to enable analysis were excluded (n=8); no attempt was made to contact the authors. The meta-analysis was conducted on a binary outcome of LBW yes/no but some studies presented the data differently, e.g. average birthweight, and could not be included (n=7). Three studies were excluded on the basis of quality and two because the measure of pregnancy intention was either not described or was incomparable with the other studies.

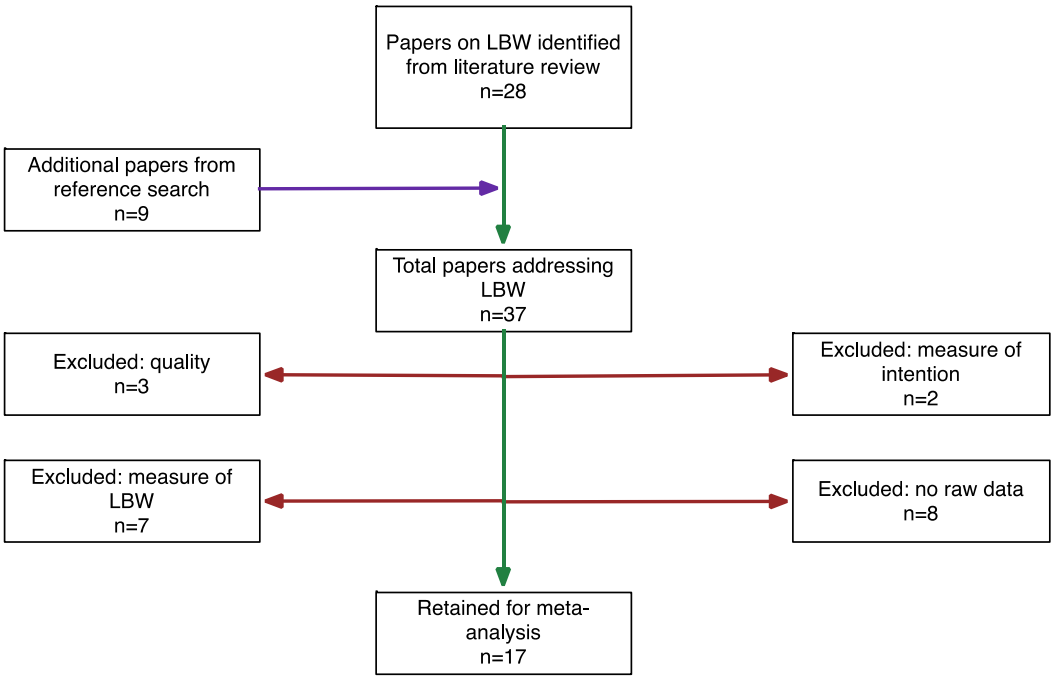


Figure 3-2 Flow chart of the studies in the pregnancy intention and LBW review

3.3.2.3 Description of included studies

Of the 17 studies remaining, 14 were from HICs (11 from the USA, two from the UK and one from Ireland), two were from LICs (one each from Ethiopia and Benin) and one from a LMIC (Ghana). Only two had assessed intentions during pregnancy and followed up women after birth (117, 161), the other 15 were retrospective, cross-sectional surveys. Study sample size ranged from just over 500 to 25,000 women as many were large, nationally representative surveys.

3.3.2.4 Meta-analyses of the unadjusted relationship

Given the range of confounders adjusted for in different studies, I used the raw data and calculated crude estimates for the meta-analysis, recognising that this might overestimate the effect. Given the heterogeneity in the studies and observed in the fixed-effects analysis, a random effects meta-analysis was performed. The forest plot of this is shown in Figure 3-3.

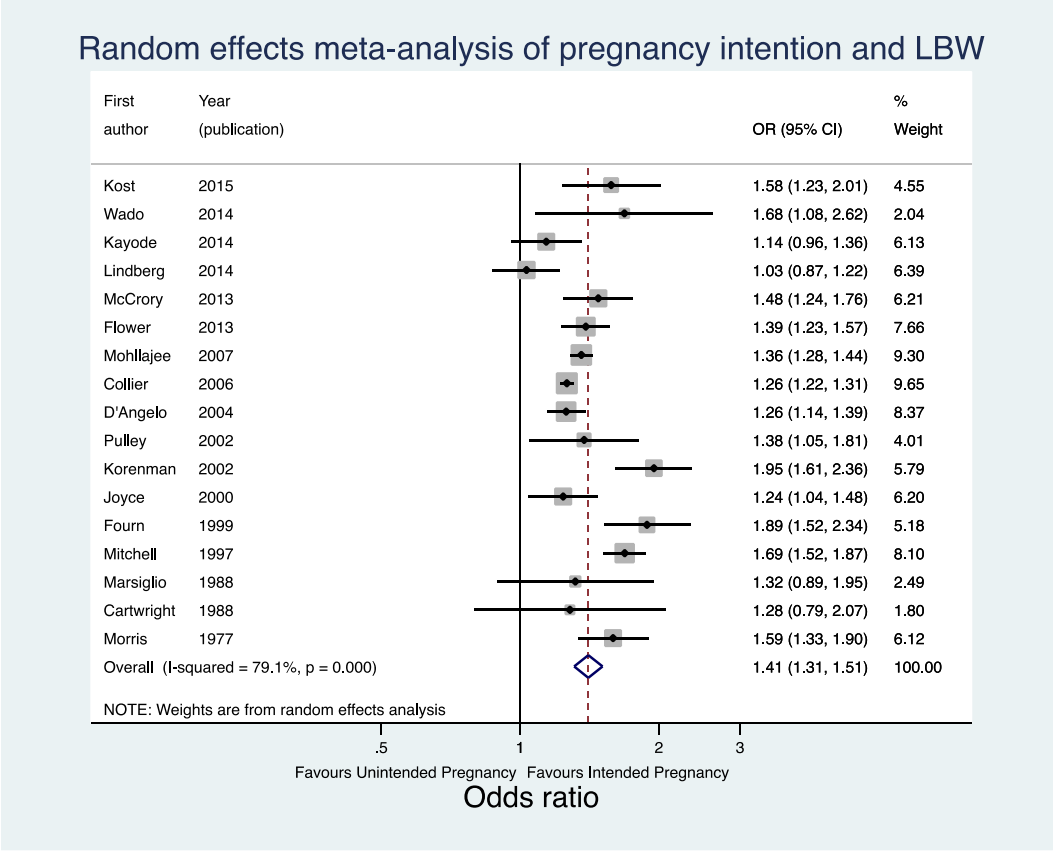


Figure 3-3 Forest plot of the random effects meta-analysis of studies assessing the relationship between pregnancy intention and LBW

This meta-analysis suggests that the odds of having a LBW baby are increased 1.41 times in women who report their pregnancy as unintended (95%CI 1.31, 1.51). Significant heterogeneity remains and may be a result of the range of locations or timing or method of assessment of pregnancy intention. Separate meta-analyses were conducted stratified for these factors, as recommended by MOOSE guidelines (127), and are shown in Figure 3-4 and Figure 3-5.

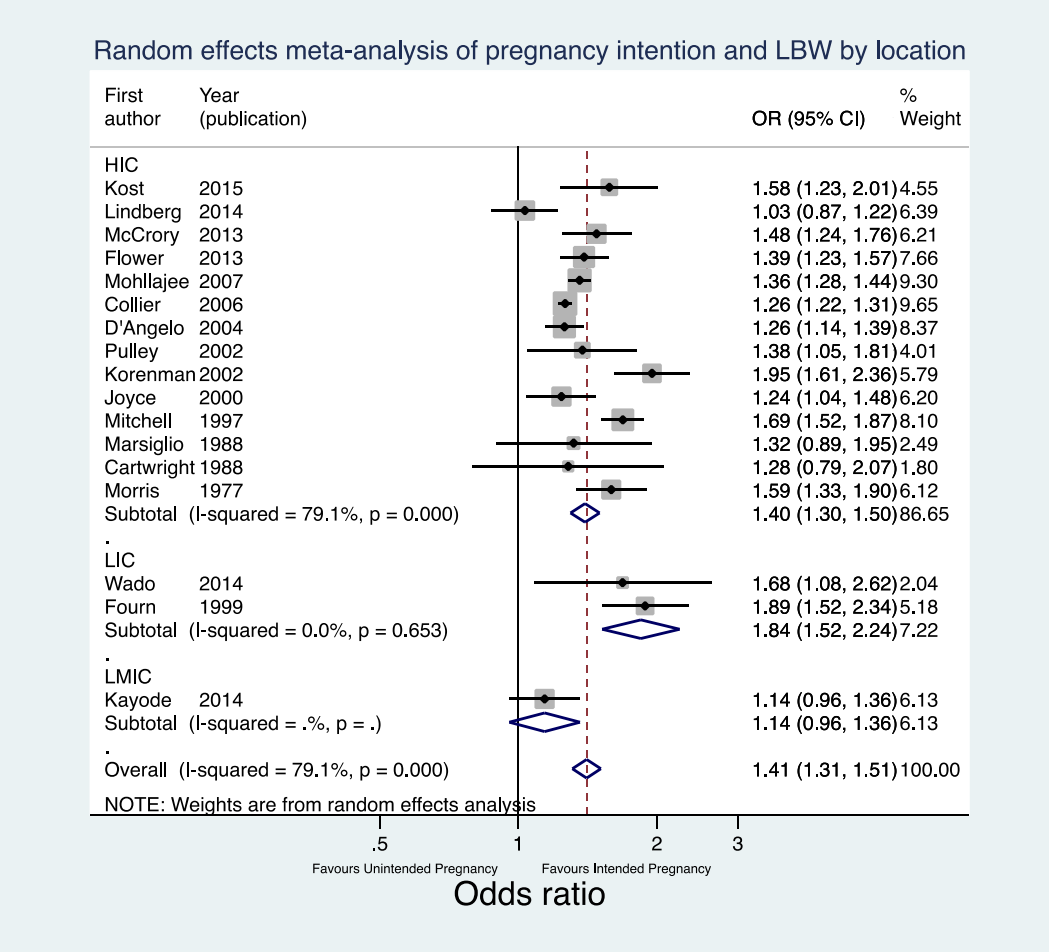


Figure 3-4 Forest plot of the random effects meta-analysis of studies assessing the relationship between pregnancy intention and LBW stratified by location

Figure 3-4 shows that the two LIC studies had a significantly higher combined OR of 1.84 (95%CI 1.52, 2.24) but the OR for HICs was not significantly different and neither was the heterogeneity much reduced in this sub-sample. Figure 3-5 shows similar findings. Since the two antenatal studies were also the two studies in LICs it is not possible to say whether the higher pooled OR in these studies was due to the location or the timing of assessment. Theoretically speaking, the antenatal assessment of pregnancy intention should lead to a smaller effect size estimate as the potential for recall bias or for the outcome to influence the reported intention has been removed. On the other hand, the setting may lead to a larger effect size as the consequences of an unintended pregnancy may be more significant in a resource constrained environment.

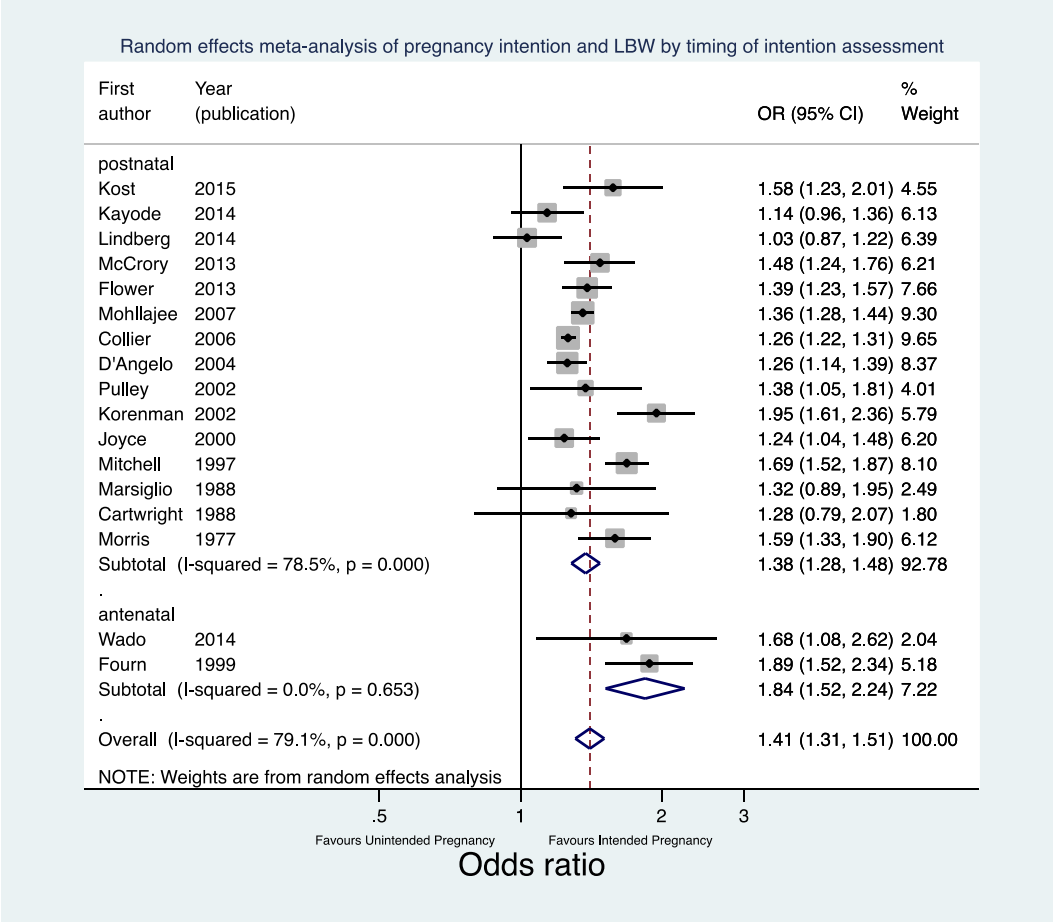


Figure 3-5 Forest plot of the random effects meta-analysis of studies assessing the relationship between pregnancy intention and LBW stratified by timing of assessment of intention

3.3.2.5 Findings of adjusted analyses

Out of these 17 studies, six calculated aORs. Two studies found non-significant relationships after adjustment (121, 166) though one had been non-significant in the unadjusted analysis (121). In two studies the findings remained significant with aORs of 1.60 (95%CI 1.30, 2.0) (161) and 1.24 (95%CI 1.04, 1.48) (165). The final studies had mixed findings. Wado et al. found that unwanted pregnancies remained significantly associated with LBW (aOR 2.08 (95%CI 1.02, 4.23)) but mistimed pregnancies were not (117). Mohllajee et al., however, found that unwanted and mistimed pregnancies had no relationship with LBW after adjusting for confounders, but women who were ambivalent had increased odds of LBW (aOR 1.15 (95%CI 1.02, 1.29)) (116). No two studies controlled for the same mix of confounders, which ranged from socio-demographic and obstetric history

factors to smoking behaviour and uptake of antenatal care, which may explain these discrepancies.

3.3.2.6 Publication bias

I created a funnel plot to check for publication bias or small study effects, as shown in Figure 3-6. The lack of studies in the bottom left hand corner indicates that smaller studies with negative findings are missing. This may be a consequence of publication bias. It may also be because, as noted in section 3.3.2.2, several of the negative studies did not present raw data and therefore could not be included in the meta-analysis.

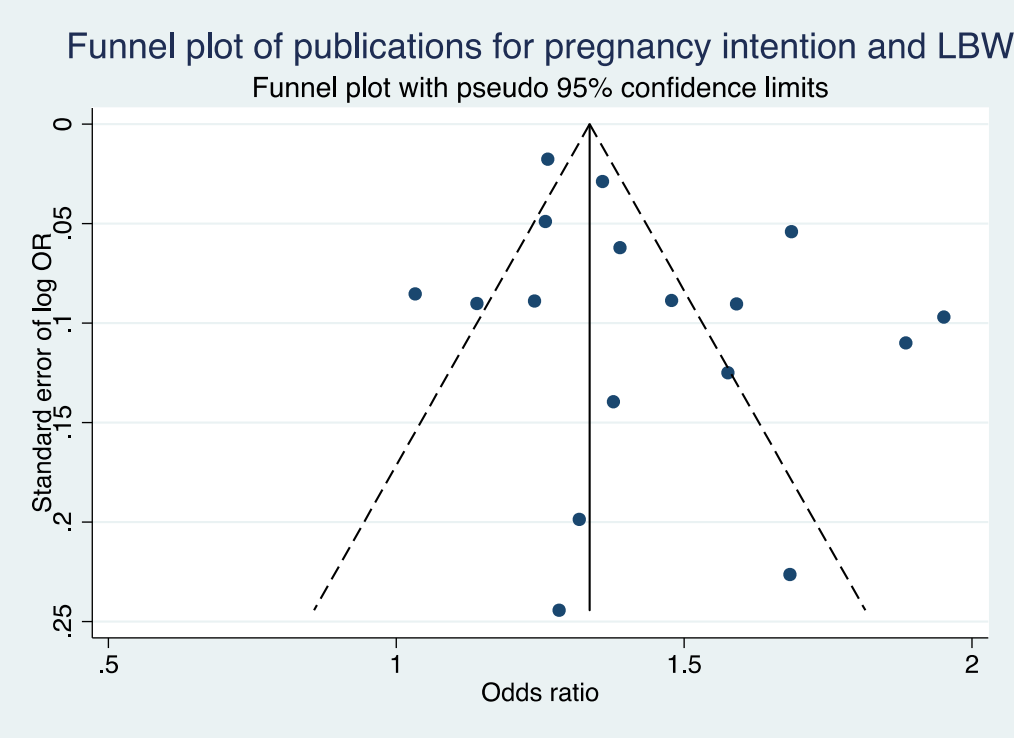


Figure 3-6 Funnel plot for pregnancy intention and LBW

3.3.2.7 Association of low birthweight with other factors

Given the expected level of missing data for low birthweight I planned to conduct multiple imputation to fill in these missing data. In order to create the multiple imputation model for birthweight it is important to be aware of the factors that influence it. Although somewhat dated, Kramer's extensive and widely cited meta-analysis of the determinants of LBW (171) found the

factors listed in Table 3-4. Those particularly relevant to LICs are shown in bold.

Factors with well-established direct causal impacts on LBW	
Socio-demographics	Racial/ethnic origin
Parental anthropometry	**Maternal height and pre-pregnancy weight**, paternal weight and height, maternal birthweight
Obstetric history	Parity, history of prior low birthweight infant
Antenatal factors	**Gestational weight gain and caloric intake**, general morbidity and episodic illness, **malaria**, cigarette smoking, alcohol consumption, and tobacco chewing
Infant factors	Sex

Table 3-4 Determinants of LBW (171)

Other studies have added more factors to this list including birth interval, maternal education and socio-economic status (172), maternal age, multiple pregnancies and antenatal care uptake (173), marital status and domestic violence (174-176) and antenatal depression (177). An assessment of the contextual risk factors for LBW in Ghana found that living in a rural area, a more deprived community or one with poorer access to safe water, were all associated with an increased risk of LBW (167). This information was used to select variables for inclusion in the multiple imputation model, as explained in section 5.2.5.

Since many of the determinants of LBW are the same factors noted to be associated with unintended pregnancy in section 3.3.4 it is important to be aware of them, and to collect data on them where possible, so that the relationships between pregnancy intention and LBW can be correctly assessed.

3.3.2.8 Summary for pregnancy intention and low birthweight

The meta-analyses of the unadjusted data suggest that unintended pregnancies are associated with increased odds of having a low birthweight baby. This finding seems robust to the location of the study and the timing of the assessment of pregnancy intention, though with the limited data available from either LICs or prospective studies this is not certain. There is some suggestion from adjusted analyses that confounders or mediators,[xii] such as socio-economic status, smoking (in HICs), maternal nutrition and uptake of antenatal care, may explain the effect of pregnancy intention on increased risk of LBW.

3.3.3 Pregnancy intention and postnatal depression

3.3.3.1 Findings of previous reviews

Over the last 20 years there have been a number of reviews of the risk factors for or predictors of postnatal depression (PND) (178-180). These reviews did identify unplanned pregnancy as a risk factor for PND; however, the included studies were almost exclusively conducted in HICs. This led Gipson et al., to conclude that the evidence for a relationship between unintended pregnancy and postnatal depression in developing countries is limited (15).

Since Gipson et al.'s review in 2008 there have been more publications in this area, including from LICs. There have been four further reviews: two reviewing the risk factors for PND in Asian cultures (181, 182), one focusing entirely on Iran (183) and, most relevant to this research, a systematic review of the determinants of common perinatal mental disorders in women in LICs and LMICs conducted in 2010 but published in 2012 (184).

These studies have all found that unwanted pregnancy is associated with PND. The Iran review, for example, found that 43.4% (95%CI 35.6, 51.1) of women with an unplanned pregnancy experienced PND, compared to 25.6%

[xii] A mediator is a variable that plays an important role in governing the relationship between the exposure and the outcome e.g. the effect of pregnancy intention (the exposure) on LBW (the outcome) may be mediated by attendance at antenatal care.

in the general population (p<0.001) (183). The review of studies from LICs and LMICs found seven studies that included the effect of pregnancy intention on PND. Five found an association and two did not but no meta-analysis was conducted. A limitation of this evidence is that most studies are cross-sectional, retrospective surveys with both pregnancy intention and postnatal depression measured in the postnatal period.

3.3.3.2 Findings of my review

I excluded 13 papers on full-text review, leaving 35. Reasons for exclusion included assessing PND before the two week cut-off set in the inclusion criteria, presenting the same data as another paper or not addressing the relationship between pregnancy intention and PND. Five of the 35 remaining papers were reviews, 25 were conducted in HICs or UMICs and five in LMICs or LICs as shown in Table 3-5.

High income countries	Upper-middle income countries	Lower-middle income countries	Low income countries
USA (185-187)	Turkey (188-192)	Egypt (193)	Uganda (194)
UK (195, 196)	Iran (197-200)	India (201)	
Bahrain (202)	Mexico (203, 204)	Pakistan (205)	
Ireland (206)	Columbia (207)	Nigeria (208)	
Japan (209)	Hungary (210)		
Qatar (211)	Jordan (212)		
Saudi Arabia (213)			
Spain (214)			

Table 3-5 Locations of studies identified in postnatal depression literature review

Six of the HIC/UMIC studies were prospective in that they recruited women during pregnancy (186, 187, 197, 206, 209, 212), the rest recruited women postnatally and were cross-sectional studies. This means that they are subject to ex-post rationalisation and recall bias.

All but two of the 25 HIC/UMIC studies found that women with unintended pregnancies were at greater risk of postnatal depression on univariate analysis (188, 202). Not all studies presented odds ratios, but of those that did they ranged from 1.50 (95%CI 1.09, 2.06) (197) to 2.79 (p<0.001) (213). One study found that the difference became non-significant on multivariate

analysis (186) but the other 13 studies that did adjusted analyses found that unintended pregnancies remained significantly associated with postnatal depression. Three of these were prospective studies (187, 197, 212) but it was another of the prospective studies that found that the difference became non-significant on multivariate analysis (186).

Given the strong evidence for a relationship in HICs from the studies I found and from previous reviews, I decided to focus my analysis on studies from LICs or LMICs as this was both a gap in the literature and more relevant to my research. As the recent review was conducted five years ago (184), I updated it by analysing the studies they included plus all the studies that I identified from my literature review that were conducted in LICs or LMICs. There were five from my review (193, 201, 205, 215, 216) plus an additional five (194, 208, 217-219) from the Fisher et al. review (184) giving a total of 10 studies. One of these was excluded on full-text review as it was looking at antenatal, not postnatal, depression (217). The characteristics of the other nine studies are shown in Appendix H.

3.3.3.3 Description of included studies

Seven of the included studies were cross-sectional in that women were recruited postnatally and both pregnancy intention and depression were assessed simultaneously (193, 194, 201, 205, 208, 215, 219). The other two recruited women during their third trimester, when they were asked about their pregnancy intention, and followed them up at six-to-eight weeks postnatally to assess depression (216, 218). Most studies relied on health facility-based recruitment; given low uptake rates of postnatal care this may affect the representativeness of the populations included in these studies and limit the generalizability of the findings.

None of the studies described the question(s) that were used to assess pregnancy intention. This is unsurprising, as this was just one of several risk factors that studies were looking at, but it indicates that they did not use a validated measure. Pregnancy intention was variously described as whether the pregnancy was ‘planned’, ‘wanted’ or ‘welcome’. As explained in

sections 2.2.1 and 2.2.5, and as I commented on in the LBW literature, these are different dimensions of the concept of intention but they are often conflated, as in these studies.

All the studies used validated measures of depression. The Edinburgh Postnatal Depression Score (EPDS) was the most common, used by five studies (193, 208, 216, 218, 219), though three different cut-points were used. Other measures used include the Self-Reporting Questionnaire (SRQ) (194), the K10 (201), the Aga Khan University Anxiety and Depression Scale (205) and the Mini International Neuropsychiatric Interview (MINI) (215). Given the lack of psychiatrists in most of these settings, the authors justified using screening measures, such as the EPDS or SRQ, as a proxy for diagnosis of depression, recognising that this would overestimate the prevalence. Two studies did use diagnostic assessments meaning their estimates of the prevalence of PND would be lower than those using a screening tool (193, 215). All studies assessed for depression between four and eight weeks after delivery; several followed up to six or even 12 months (193, 205, 215, 218).

Eight of the studies found that unplanned pregnancies were more common in women who screened positive for postnatal depression (193, 194, 201, 205, 208, 216, 218, 219). The one that did not was the smallest study so may have lacked power as many of the socio-demographic factors normally associated with postnatal depression were also not significant in this study (215).

3.3.3.4 Meta-analysis of the unadjusted relationship

Of the nine studies, seven had extractable data for meta-analysis. Two of these had errors and inconsistencies in the analyses in the tables and text leading me to question the results (194, 205). These were therefore excluded from the meta-analysis leaving five studies (193, 201, 215, 216, 219). As per the LBW review, I extracted the raw data from the studies and calculated unadjusted odds ratios in Stata for the meta-analysis. For consistency I used the assessment of PND conducted between four and

eight weeks postnatally. Given the heterogeneity in the studies observed on fixed-effects analysis, a random effects meta-analysis was performed. The forest plot of this is shown Figure 3-7.

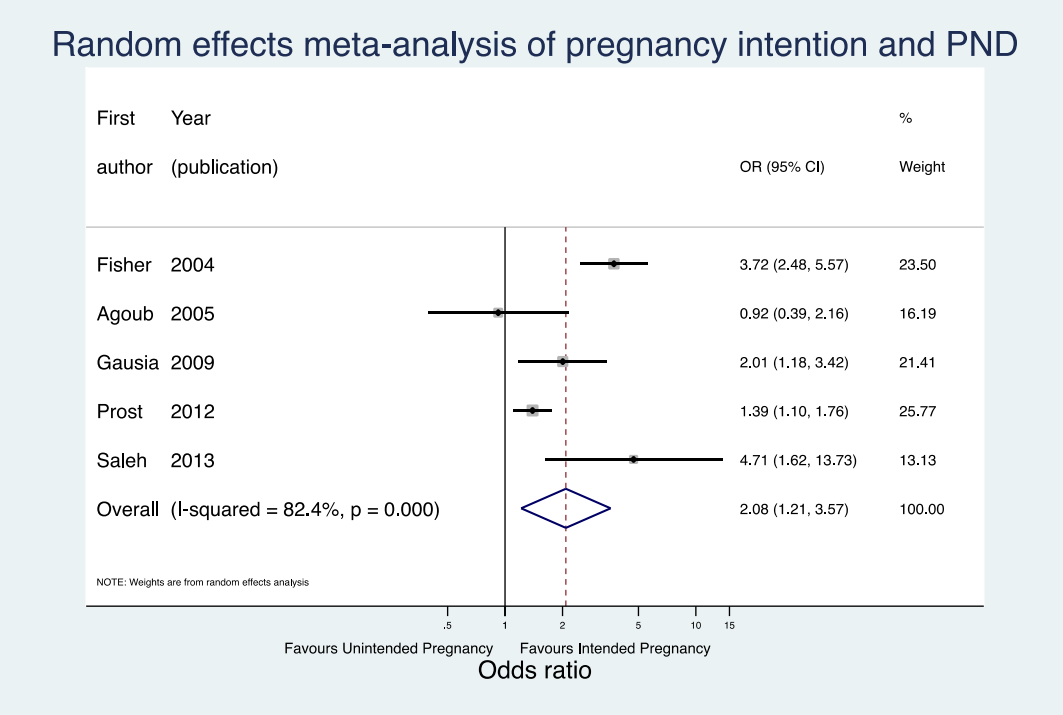


Figure 3-7 Forest plot of the random effects meta-analysis of studies assessing the relationship between pregnancy intention and PND

This meta-analysis suggests that the odds of having PND are increased 2.08 times in women in LICs or LMICs who report their pregnancy as unintended (95%CI 1.21, 3.57). Significant heterogeneity remains and may be a result of the range of locations or different methods of assessment of postnatal depression and pregnancy intention. There were insufficient studies to do sub-analyses by these factors. All but one of these studies (216) assessed pregnancy intention postnatally so we can only comment on association, not causation. Given the small number of studies I did not do a funnel plot to formally check for publication bias, though there is clearly a bias in that there are so few studies from LICs and LMICs.

3.3.3.5 Findings of adjusted analyses

Six of the nine studies conducted adjusted analyses though, like the LBW studies, a range of confounders were controlled for in different studies. In

only one study did the relationship become non-significant; it is noteworthy that this was a study in which pregnancy intention had been assessed antenatally (216). In the others the aORs ranged from 1.49 (95%CI 1.12, 1.97) (201) to 2.30 (95%CI 1.6, 3.3) (219).

Antenatal depression has been found to be associated with unintended pregnancy across a range of studies and settings (63, 122, 220-227). It is therefore possible that unintended pregnancies cause antenatal depression that persists into the postnatal period rather than causing true postnatal depression, which is a depression that starts in the postnatal period (128). Furthermore, unintended pregnancies are more likely in women with pre-existing depression or anxiety (228) so it may be *this* depression that is carried into pregnancy and the postnatal period. The cross-sectional nature of most of the data makes unpicking these relationships impossible and indicates a need for prospective studies.

3.3.3.6 Association of postnatal depression with other factors

Since many of the factors associated with postnatal depression are other primary outcomes of interest or are the same as those noted to be associated with unintended pregnancy in section 3.3.4, it is important to be aware of them, and to collect data on them where possible, so that the relationships between pregnancy intention and PND can be correctly assessed.

In 2001 Beck updated her previous meta-analysis of the predictors of PND (180). This meta-analysis of 84 papers, almost entirely from HICs, revealed 13 significant predictors of postnatal depression, shown in Table 3-6.

Predictors of postnatal depression	
Socio-demographics	Socio-economic status, marital status and quality of marital relationship
Antenatal factors	Antenatal depression or anxiety, unplanned or unwanted pregnancy
Infant factors	Infant temperament
Postnatal factors	Maternity blues
Other	Previous depression, self-esteem, childcare stress, social support, life stress

Table 3-6 Predictors of postnatal depression in HICs (180)

Some of these factors are perhaps more applicable to HICs than LICs. The determinants of common perinatal mental disorders in LICs and LMICs were described by Fisher et al.'s 2012 review (184) and are shown in Table 3-7.

Predictors of postnatal depression in LICs and LMICs	
Socio-demographics	Maternal age, maternal education, marital status, not being in the ethnic majority, socio-economic status, no permanent job
Antenatal factors	Antenatal depression or anxiety, unplanned or unwanted pregnancy
Infant factors	Infant sex (in some settings)
Other	History of mental health problems, intimate partner violence, hostile in-laws, lack of partner empathy / support, partner not kind or trustworthy, insufficient emotional and practical support

Table 3-7 Predictors of postnatal depression in LICs and LMICs (184)

Maternal anaemia, infant health problems, the death of the infant or difficulties with breastfeeding also seem to be associated with postnatal depression in other studies (194, 201, 205, 215, 216, 218, 219, 229). Infant sex is important in Asian settings where male babies are preferred but there is no strong gender preference in Mchinji District.

Antenatal depression, though an important determinant of postnatal depression, has been much less widely studied in its own right. In HICs the prevalence has been estimated at between 8.5-11% depending on the trimester (230); in reviews of studies in Africa it has been estimated at between 11.3% (95%CI 9.5, 13.1) (231) and 15.6% (95%CI 15.4, 15.9) (184). These reviews found inconclusive evidence on the determinants of maternal antenatal mental health in these settings, partly due to the paucity of data. From the wider literature there is some evidence that increasing age and parity, socio-economic status, education, previous pregnancy loss, intimate partner violence and unwanted pregnancies are associated with antenatal anxiety and depression (217, 222, 225, 226, 232).

3.3.3.7 Summary for pregnancy intention and postnatal depression

The findings of previous literature reviews suggest that, in HICs and UMICs, unintended pregnancies are a risk factor for postnatal depression. This relationship seems to be robust to adjustment for confounders and to the assessment methodology.

The findings of my literature review show that, while the data from LMICs and particularly LICs are much sparser, there is more evidence than when Gipson et al.'s review was published. These LMIC/LIC studies also indicate that women with postnatal depression are more likely to report their pregnancies as unintended. However, the current studies are limited by their cross-sectional nature, lack of a robust measure of pregnancy intention and failure to take account of important antecedents to postnatal depression, such as antenatal depression.

3.3.4 Determinants of pregnancy intention

Unintended pregnancies can and do affect women of all age groups, marital status, ethnicities and socio-economic groups. However, the incidence does vary according to a range of factors; factors that are also involved in many of the outcomes of interest and are therefore potential confounders or mediators. To inform which data were to be collected (Chapter 4), the development of the conceptual models (Chapter 5) and the choice of

hypotheses for the validation of the LMUP (Chapter 6), I reviewed the literature on the determinants of intention and describe it here.

There is a strong relationship between unintended pregnancy and age that has been reported in multiple studies e.g. (63, 74, 110, 114, 120, 121, 124, 131, 159, 165, 166, 233-237). Teenagers are particularly likely to report their pregnancy as unintended and there is also a higher incidence of unintended pregnancies at the end of the reproductive lifespan in women in their 40s (118, 119). Where studies have disaggregated unintended pregnancies into mistimed and unwanted it can be seen that the women who experience these two types of unintended pregnancy are often different in terms of a number of determinants (114, 115, 120-122). For example, mistimed pregnancies are more common in younger, generally unmarried women whereas unwanted pregnancies are more common in older, usually married, women. Unmarried women are more likely to report their pregnancies more unintended than married women (74, 120, 121, 159, 165, 166, 235, 238, 239), as are women of lower socio-economic status (SES) (74, 110, 114, 115, 118-121, 159, 165, 166). Parity and ethnicity are also associated with intention. Second and third pregnancies are usually more intended than either first or higher order pregnancies (110, 114, 116, 119-121, 131, 159, 165, 235-237, 239, 240) and, in HICs, women in black or minority ethnic (BME) groups generally have higher rates of unintended pregnancy (12, 74, 110, 116, 120, 121, 131, 159, 165, 166, 235). There are fewer studies looking at birth interval, but where this has been investigated short birth intervals (less than 24 months) are associated with unintended pregnancies (241, 242). Women with higher levels of education have more planned pregnancies across a range of settings (63, 74, 110, 114-116, 120, 121, 159, 162, 165, 166, 233-235, 237-240). Finally, women who have experienced one unplanned pregnancy are at increased risk of experiencing another (243-246).

These factors tend cluster, for example in the case of an adolescent who is pregnant she is more likely to be unmarried, from a BME group and of lower SES making it hard to know which factors are most important.

3.3.4.1 Multivariate analyses in low-income settings

Several studies have reported on the prevalence of unintended pregnancy and its correlates in a selection of LICs and LMICs using multivariate methodologies (238, 245, 247-255). However, some of their findings have been inconsistent, as shown in Table 3-8, making it difficult to draw conclusions as to the important determinants in these settings.

Study	Factors in analysis (significant factors in bold)
Beguy, 2014, Kenya (238). UIPs* in women aged 15-22 in two slums. Logistic regression.	Age, slum, SES, religion, **currently in school, currently married**, ethnicity, relationship with first sex partner, **age at first sex**, used contraception at first sex, **parent(s) living at home.**
Calvert, 2013, Tanzania (247). UIPs in women aged 15-30. Hierarchical logistic regression.	**Age**, ethnicity, religion, **education**, **occupation**, **marital status**, time away in the past year, **knowledge of: where to access condoms;** where to access free condoms; HIV/STI acquisition; pregnancy prevention, attitude towards sexual health, **age at first sex**, **number of partners**, ever use of modern contraception, casual or regular partner in last year.
Ikamari, 2013, Kenya. (248) UIPs in women aged 15-49 in slum and non-slum settings in Nairobi. Logistic regression.	In slum settings: **age**, SES, ethnicity, education, occupation**, marital status**, **parity and household size.** In non-slum settings: age, SES, **ethnicity**, education, **occupation, marital status**, parity and household size**.**
Dixit, 2012, India (249). Case-control study of national level data, matched on village and woman's age.	**Religion,** caste**, SES,** woman's education, **partner's education, ever use of modern contraception, sex of last child, sex composition of living children,** experience of child loss**, birth interval.**
Eggleston, 1999, Ecuador (250). Logistic regression of national level data.	**Age, area of residence, SES**, education, **marital status, parity**, **used modern contraception before most recent pregnancy,** number of modern methods known.
Eliason, 2014, Ghana (251). Pregnant women attending ANC. Logistic regression.	**Marital status, parity, partner lives in same house,** aware of modern contraception, **aware of traditional contraception**, ever use of traditional contraception.
Hamdela, 2012, Ethiopia (245). Cross-sectional survey of married pregnant women. Logistic regression.	Age, education, **parity**, family size, **previous unintended pregnancy, desired number of children, husband's desired number of children.**
Mazharul, 2004, Bangladesh (252). Analysis of DHS data. Logistic regression.	**Age, area of residence, rural v urban, SES**, **education,** employed, **parity, age at first marriage, used modern method of contraception.**
Melian, 2013, Paraguay (253). Analysis of DHS data. Logistic regression.	**Age, rural v urban,** SES, employed, **education, marital status, number of living children.**
Sedgh, 2006, Nigeria (254). Cross-sectional survey of women aged 15-49. Logistic regression.	Age**, region, residence, religion, SES,** education**, marital status, parity, ever used contraception.**
Tebekaw, 2014, Ethiopia (255). Analysis of DHS data of ever-experience of unwanted birth. Logistic regression.	**Age,** rural v urban, **religion, ethnicity, SES**, **education, employed, parity, marital status, household size, knowledge of contraception, use of contraception,** media exposure, **decision-making power**, history of abortion.

Table 3-8 Findings of multivariate analyses of the determinants of unintended pregnancy in LICs and LMICs
*UIPs are 'unintended pregnancies'

3.3.4.2 Studies using the London Measure of Unplanned Pregnancy

In the last two years there have been three studies that have used the LMUP to describe the determinants of pregnancy intention in Australia, Denmark and the UK (63, 239, 256). Two were studies involving currently pregnant women (239, 256); the other was a nationally representative cross-sectional survey of women who had been pregnant in the last year (63). Instead of using the full range of LMUP scores in the analysis, all three used the LMUP to dichotomise pregnancies. Two used the standard cut-point of 9/10 (239, 256) to divide pregnancies into planned or unplanned. The third used an unusual cut-point of 3/4, grouping 'ambivalent' (scores 4-9) with 'planned' (scores 10-12) rather than 'unplanned'.

Neither the Danish nor the British studies did multivariate analyses. On univariate analysis, the Danish study found that pregnancy intention was associated with education, parity, living with a partner and having had fertility treatment, but not with age, ethnicity, employment status or chronic disease (239). The UK data from the National Survey of Sexual Attitudes and Lifestyles showed that, on univariate analysis, pregnancy intention was associated with age, relationship status and number of living children (63). In Australia, multivariate logistic regression showed that pregnancy intention was associated with age, marital status and cultural background, but not with religion, employment or education; parity was not considered (256).

The UK study is limited by the cross-sectional retrospective data, the lack of multivariate analysis and the choice of cut-point for comparing intended and unintended pregnancies (63). The Danish study is better, as it interviewed women in pregnancy and used the standard cut-point, but the lack of multivariate analysis is unhelpful (239). The strongest is the study in Australia where women were interviewed in pregnancy, the standard cut-point was used and a multivariate logistic regression was performed. While these studies have used a validated measure of pregnancy intention they have still dichotomised pregnancy intention, against the advice of the designers of the LMUP (8), losing some of the information they had gained from using a more nuanced and accurate measure.

3.3.4.3 Summary for the determinants of pregnancy intention

While the relationships of age, marital status and parity to pregnancy intention are fairly consistent, factors such as education and SES are less clear-cut. There are several possible reasons for these differences. Firstly, it may be because different studies looked at range of settings (HICs, LICs, rural, urban, slums) in diverse countries where the determinants may genuinely be different. Others looked at particular sub-groups of women, such as young (238, 247) or married women (245, 252) where, again, the determinants may be different. Secondly, it may be due to the limitations of the cross-sectional DHS-style methodology used by most studies, which may have introduced recall bias and misclassification. Several studies also compared ever-experience of an unintended pregnancy with current socio-demographic factors, which may further obscure the relationships (247, 255).

Thirdly, some studies may have missed important factors as they have considered different sets of correlates, meaning that they have not been able to fully describe the relationships between determinants of pregnancy intention or deal with residual confounding. For example, two studies did not collect data on parity (247, 256) and two others did not consider SES (245, 251). Fourthly, a range of different measures of pregnancy intention was used which may make the findings non-comparable as it could be argued they were not measuring the same exposure. Finally, where multivariate analyses have been done, most studies' analyses were not hierarchical (see section 5.4.3 for an explanation of hierarchical analysis) therefore all variables were included in the model simultaneously. Using this methodology, the ways in which distal determinants, such as SES, mediate the effects of pregnancy intention through more proximal determinants is not explored. This may lead to the conclusion that the distal determinants are not important, rather than describing how their effect is mediated.

3.3.5 Pregnancy intention and other outcomes of interest

This section presents the evidence for the relationships between pregnancy intention and other outcomes of relevance that I found during the literature review and over the course of the research.

3.3.5.1 Antenatal care

For antenatal care, the bulk of the evidence points to delayed uptake and fewer total visits in women with unintended pregnancies (105, 115, 116, 120, 121, 163, 165, 168, 169, 233, 235-237, 257-262), though there have been some negative findings (124, 125, 263). As previously noted, studies often fail to control for confounders; in this instance pregnancy recognition is also important and is often delayed in unintended pregnancies (120, 121, 259, 264).

A 2013 systematic review and meta-analysis on the topic found that unintended pregnancies were associated with delayed initiation of antenatal care (OR 1.42 (95%CI 1.27.1.59)) and inadequate antenatal care (OR 1.64 (95%CI 1.47.1.82) (265)). These findings were robust to location (developed versus developing countries) and whether pregnancy intention was assessed prospectively or retrospectively (although only six of the 32 identified studies were prospective).

3.3.5.2 Maternal behaviours during pregnancy

There are several studies in HICs that have reported on vitamin use (specifically folic acid), smoking and drinking alcohol during pregnancy. Smoking and drinking alcohol before and during pregnancy seem to be more common in unintended pregnancies (63, 105, 116, 121, 165, 235, 262, 266-269) and taking vitamins / folic acid less common (131, 239, 266, 267, 269-271). The Danish study that used the LMUP measured pregnancy intention in pregnant women of 12-16 weeks' gestation and related this to folic acid use, alcohol consumption and smoking (239). They found higher median LMUP scores (more planned pregnancies) in women who were taking folic acid, drinking less alcohol and who had stopped smoking prior to pregnancy.

Although methodologically robust this study did not adjust for any confounders so may overestimate these relationships. Dott et al. noted that, after recognition of pregnancy, the degree to which women changed their behaviour, e.g. whether or not they stopped smoking, was also associated with pregnancy intention (266).

A few studies have found mixed or no effects. Marsiglio and Mott found no relationship with pregnancy intention and smoking or drinking (169) and although Joyce et al. found a significant relationship between pregnancy intention and smoking even after controlling for confounders, this effect was diminished in within-family fixed-effects models (162).

Most of these studies are retrospective. One study comparing intentions during and after pregnancy found that the retrospective assessment of intention did indeed overestimate the relationship between pregnancy intention and maternal behaviours (105).

Overall, it seems that unplanned pregnancies are associated with riskier maternal behaviours during pregnancy. However, all the evidence is from HICs and is mostly about smoking and drinking alcohol, behaviours that are not particularly relevant to LICs. I found no studies looking at preventative care practices relevant to LICs, such as sleeping under an insecticide treated bed net or taking intermittent preventative treatment for malaria during pregnancy, so this is a major gap in the literature.

3.3.5.3 Delivery care

Delivery location and skilled birth attendance are factors of greater relevance to LICs where women tend to have poorer access to such services. I found five studies looking at this, all based on cross-sectional DHS-style data. One study found that the significant univariate relationship between pregnancy intention and facility-based delivery disappeared in the multivariate analysis (237) and three found residual relationships with mistimed but not unwanted pregnancies (114, 123, 124). Mistimed pregnancies were also more likely to be delivered by a traditional birth attendant or a relative than intended pregnancies (123). The final study, Marston and Cleland's comparison of

DHS data from five countries, found no effect of pregnancy intention on unsupervised delivery in three of five countries (Bolivia, Kenya and the Philippines), an increase in unsupervised delivery for unwanted pregnancies in Peru (aOR 1.21 (95%CI 1.06, 1.38) and a decrease in Egypt (125).

Although limited by the retrospective, cross-sectional nature of these data, it seems that pregnancy intention has less of an influence on type of delivery care once the potentially confounding maternal characteristics have been controlled for.

3.3.5.4 Breastfeeding

Most studies on breastfeeding have found higher rates and/or longer durations of breastfeeding in children of intended pregnancies in both HICs and LICs (105, 120, 121, 163, 168, 236, 259, 272-277). For example, in the USA, Lindberg and Kost found that unwanted children were less likely to be breastfed than wanted children having used propensity score analysis to adjust for a wide range of maternal background characteristics (121) and Joyce et al. found that unwanted children were less likely to be breastfed than wanted children within the same family (162). In Argentina, Berra et al. found that having an unplanned pregnancy was predictive of cessation of breastfeeding before six months in a multivariate logistic regression model (aOR 1.50 (95%CI 1.05, 2.15)) (274). In Ghana, Chinebuah and Perez-Escamilla's backward stepwise multivariate logistic regression showed that planned pregnancies led to a significantly greater median duration of breastfeeding than unintended pregnancies (21.1 vs. 18.5 months) in women having their first pregnancy (276).

On the other hand Marsiglio and Mott found a strong univariate relationship between pregnancy intention and breastfeeding that disappeared in the adjusted analysis due to confounding by maternal age and ethnicity (169). Similarly the univariate relationship seen in the UK was removed once social class was controlled for (59), and pregnancy intention was not an important factor in the duration of breastfeeding in Bolivia or Paraguay on multivariate analysis (278).

While some studies have found no relationship once potential confounders have been controlled for, overall the weight of evidence seems to be towards an effect of pregnancy intention on breastfeeding, even after adjusting for confounders.

3.3.5.5 Immunisations and postnatal care uptake

I found four studies looking at the relationship of pregnancy intention to immunisation uptake in the resulting child. One found no relationship between pregnancy intention and whether the child had received its second dose of polio (OR 1.26 (95%CI 0.80, 2.00)) (240); a second was a multi-country study of DHS data that found mixed results (125). In Egypt mistimed births were more likely to have incomplete vaccinations at age one (OR 1.40, 95%CI 1.08, 1.82) and in Kenya and Peru unwanted births were at greater risk of incomplete vaccinations (OR 1.60 (95%CI 1.12, 2.28) and OR 1.24 (95%CI 1.09, 1.41) respectively) but there were no differences in either Bolivia or the Philippines. The last two studies were both in India. The first found that the children of unwanted or mistimed pregnancies were more likely to have partial or no vaccinations (aOR 2.17 (95%CI 1.52, 3.08) and aOR 1.41 (95%CI 1.10, 1.79) respectively) on multivariate analysis (114). The other only found a significant effect for unwanted pregnancies (aOR 1.38 (95%CI 1.01, 1.87)) (115).

For postnatal care in HICs univariate relationships are seen, where the children of unintended pregnancies are less likely to be taken to well-baby checks (169) or are taken less frequently (259). These findings are negated on multivariate analysis, though Crissey noted that the offspring of unwanted pregnancies were more likely to be reported by the mother as being in '*less than excellent health'* (p604) (279).

In other settings data from the DHS in 11 countries showed that the children of unintended pregnancies were more likely to become ill but were no less likely to be taken to health services (280). Conversely a study in Indonesia showed that the children of unintended pregnancies were more likely to be ill and less likely to be taken for treatment (281).

Based on these data there may be a relationship between pregnancy intention and illness in the child, immunisation and care-seeking behaviour but this may be context specific and may be explained by confounders.

3.3.5.6 Stunting as an indicator of malnutrition

Several studies in LICs have found a significant increase in the prevalence of stunting[xiii] in children from unintended pregnancies (125, 136, 282). A 30% greater risk of stunting was observed in the children of unintended pregnancies in Bolivia (282) and a 15% increase in Peru (125). A third study found significantly lower height-for-age in the Dominican Republic (136) and a study in India found an aOR of 1.31 (95%CI 1.06, 1.63) for stunting in the children of unwanted pregnancies (114). Two of these studies were multi-country comparisons of DHS data and they saw no relationships in Kenya, Bolivia, Egypt, Thailand and the Philippines (125, 136).

These mixed findings make it difficult to draw conclusions on the relationship between pregnancy intention and stunting. The effect may be dependent on the extent of the problem of malnutrition in the setting or, again, could be due to other confounding factors.

3.3.5.7 Child development, abuse and mental health

There are few studies on pregnancy intentions and child development and they are mostly from the USA and other HICs. Several studies have found that any apparent effect of pregnancy intention on emotional or cognitive development is removed once socio-demographic, economic and family characteristics are taken into account (162, 166, 279, 283-286). de La Rochebrochard and Joshi conclude that '*for socially disadvantaged children, having resulted from an unplanned pregnancy does not seem to increase their already disproportionate risk of cognitive delay. Births after unplanned conceptions are mainly a symptom, rather than a source, of disadvantage*' (p910) (285).

[xiii] A child who is stunted is more than two standard deviations below the mean height-for-age of the reference population.

Very few studies have looked at longer-term outcomes for the child or the parent-child relationship. Parenting difficulties were more common in unintended pregnancies in Japan (287), and in Denmark, unwanted pregnancy and parents' negative expectations of the child were significant predictors of relationship disturbances at 1.5 years (288). Women in the USA who had unwanted births had lower quality emotional relationships with all their children, not just the unwanted one(s) (289). In the UK it was found that unintended pregnancies were associated with subsequent maltreatment for children who had been followed until their sixth birthday (aOR 2.92 (95%CI 1.83, 4.64)) (290).

Children of prospectively recorded unplanned pregnancies in Australia who were followed to age 14 were more aggressive, displayed more externalized behaviours,[xiv] reported more total problems and more alcohol drinking after adjusting for confounders (291). Even longer term, Axinn et al. reported that the children of unintended pregnancies (as reported in the first year after birth) have significantly lower self-esteem at 23 years of age after adjusting for confounders (292). Furthermore data from Poland showed that the children of women who were refused abortion were more likely to became psychiatric patients (especially psychiatric inpatients) than either their siblings or matched controls at 35 years old (293).

As we saw in section 3.3.3.6, unintended pregnancies appear to be a risk factor for antenatal and postnatal depression or may occur in women with pre-existing depression. Postnatal depression has also been shown to have adverse effects on the cognitive and social development of the child (294, 295) perhaps through interference with the mother-infant bond (296).

From these studies it would seem that differences in cognitive outcomes between intended and unintended pregnancies are mostly due to the socio-economic and family-level factors that underlie both. However, there may be an effect on the relationship between the mother and child, possibly related

[xiv] Externalising behaviour refers to problems that are manifested in outward behaviour and reflect a child's negative reactions to his or her environment. They include aggression, delinquency, and hyperactivity.

to postnatal depression, which could explain the higher levels of negative behaviours and mental health problems seen in these children later in life.

3.3.5.8 Maternal mortality

Although no studies have directly investigated the relationship between pregnancy intention and maternal mortality there are strong theoretical reasons for such an association to exist. Unintended pregnancies are more common in women at the very beginning and very end of their reproductive lifespan and pregnancies during this time are known to carry a greater risk of maternal mortality (297). Some women with unintended pregnancies will seek abortion; in countries where this is illegal it is likely to be an unsafe abortion. Unsafe abortion led to an estimated 47,000 maternal deaths in 2008, nearly 13% of all maternal deaths (298). In 2012 the Guttmacher Institute calculated that meeting the unmet need for family planning globally would *'prevent an additional 54 million unintended pregnancies, including 21 million unplanned births, 26 million abortions (of which 16 million would be unsafe) … and 79,000 maternal deaths'* (p1) (3) annually.

3.3.5.9 Intimate partner violence

I found 35 papers on the relationships between pregnancy intention, intimate partner violence (IPV) and pregnancy outcomes in my literature review. Studies from a wide range of settings have consistently found a relationship between unintended pregnancy, IPV and adverse outcomes, e.g. (174, 175, 299-305), although they were often unable to determine cause from effect due to their retrospective cross-sectional nature. Over the last few years a number of systematic reviews have concluded that IPV is associated with unintended pregnancy and that IPV during pregnancy is associated with adverse outcomes such as miscarriage, stillbirth, LBW, preterm birth, neonatal death, maternal depression and reduced breastfeeding (176, 306, 307). These findings suggest that IPV is an important potential confounder in the relationship between pregnancy intention and pregnancy outcomes.

3.3.6 Limitations

There are three main limitations to these reviews. Firstly, the searches were only conducted on databases and therefore did not include unpublished studies, the grey literature or consultation with experts. This could mean that relevant studies were missed. However, the search results were supplemented by searching the reference lists of identified studies. Both my LBW and PND reviews identified more studies than previous reviews in these areas had. Secondly, I did not contact authors to obtain raw data if it had not been presented in the study. This meant that some eligible studies could not be included in the analysis and seemed to be more likely to occur when studies found no relationship. This could lead to an over-estimate of the relationships between intentions and outcomes. Finally, I was the only person to screen the titles, abstracts and full-texts and to extract the data, reducing the objectivity of the results and increasing the risk of error. Normally at least two people would do this, discussing differences to achieve consensus.

3.3.7 Summary of findings from the literature review

There are varying amounts of data for the relationships between pregnancy intention and the maternal and neonatal outcomes of interest to this research. There is a suggestion that pregnancy loss may be higher in unintended pregnancies in LICs and that unintended pregnancies are associated with increased neonatal mortality in both HICs and LICs after adjusting for confounders. However, there are limited data in this area and there is no exploration of the mechanism of effect. For LBW the evidence is limited by its retrospective nature but in HICs unintended pregnancies seem to be more likely to result in a LBW baby. Some of the observed relationship may be due to confounding or unexplored mediation by maternal pre-conception and antenatal behaviours. Data from LICs and from prospective studies are still lacking but, from the existing evidence, LBW may also be more common in unintended pregnancies in LICs. There has been more published data from LICs on pregnancy intention and PND in recent years, though it is still sparse. From these data, the relationship seen between

unintended pregnancy and PND in HICs appears to exist in LICs, even after adjustment for confounders. Again, most evidence in this area is methodologically limited, in particular failing to consider previous and antenatal depression in the analysis.

We have seen that the determinants of pregnancy intention (section 3.3.4) are often the same as the risk factors for adverse outcomes (sections 3.3.1.4, 3.3.2.7 and 3.3.3.6). Furthermore, pregnancy intention and some of its determinants are related to lower uptake of preventative care practices during the antenatal, intra-partum and postnatal periods and to higher levels of risky behaviours during pregnancy (section 3.3.5), which are also known to increase the risk of adverse outcomes. Therefore the effect of pregnancy intention on pregnancy outcomes is likely to be confounded by these factors but most studies have not sufficiently accounted for this in their analyses.

This review has highlighted some gaps and flaws with the existing evidence. The general lack of studies in developing countries noted by Gipson et al. in their 2007 search (15) persists, though there have been more studies in these areas over the last few years. Research on relevant antenatal behaviours, such as bed-net use and intermittent preventative treatment for malaria during pregnancy, is non-existent.

Despite much academic debate around the construct and measurement of pregnancy intention, this does not yet appear to have translated into methodologically improved research in this area. Studies continue to be dominated by cross-sectional, retrospective surveys where the temporal separation between cause and effect is lost.

Pregnancies continue to be dichotomised into intended and unintended pregnancies on the basis of any one of the questions that were critiqued in section 2.3. These are all assumed to be measuring the same construct despite evidence to the contrary. Some studies have begun to disaggregate unintended pregnancies into mistimed and unwanted during analysis and in doing so are uncovering differential effects and determinants, reinforcing the need for a more refined measure of pregnancy intention. To date very few

studies have assessed pregnancy intention using a psychometrically validated measure and so it should perhaps not be surprising that so many apparent inconsistencies have been found in the data. The recent use of the LMUP is encouraging but so far has only occurred in HICs and, strangely, was used to dichotomise intention rather than making use of the full range of scores to explore associations.

The investigation of the relationships between pregnancy intention and key maternal and neonatal health behaviours and outcomes would benefit from exploration in longitudinal studies. In these studies pregnancy intention should be measured before birth and data on the potential confounders and mediators, including maternal background characteristics, pre-conception, antenatal, delivery and postnatal behaviours, should be collected. A psychometrically valid measure of pregnancy intention that assesses intention on a continuous scale, such as the London Measure of Unplanned Pregnancy, should be used in preference to dichotomous measures. Where it is used, the full range of scores should be used in the analysis. Multivariate regression methodologies that enable an exploration of the ways in which pregnancy intention influences pregnancy outcomes, as well as the factors that influence pregnancy intention, should be utilised. While these methodological advances are required in research in high-income countries, research in low-income countries, where arguably the consequences of unintended pregnancies are much greater, is urgently needed.

3.4 Chapter summary

In this Chapter I have described the methodology and results of my systematic review of the literature on the relationships between pregnancy intention and my primary outcomes for maternal and neonatal health. Relevant data on the determinants of pregnancy intention and the primary outcomes, as well as the relationship of pregnancy intention with other behaviours or outcomes, has also been presented. The next Chapter will explain how the cohort of pregnant women in Mchinji District was recruited, interviewed and followed up to collect the data to explore the relationships

between pregnancy intention and maternal and neonatal outcomes in Mchinji District, Malawi.

Chapter 4 Recruitment and data collection

This Chapter describes how the cohort was established, including sample size calculations, the selection of areas for inclusion in the research, the recruitment and training of the team, the identification of pregnant women for interview from the pre-existing surveillance system and the development of the data collection system and questionnaires. Ethical issues and the processes for gaining local approvals are discussed. The next Chapter will explain the data management and cleaning processes and the analysis plan.

4.1 Sample size calculation

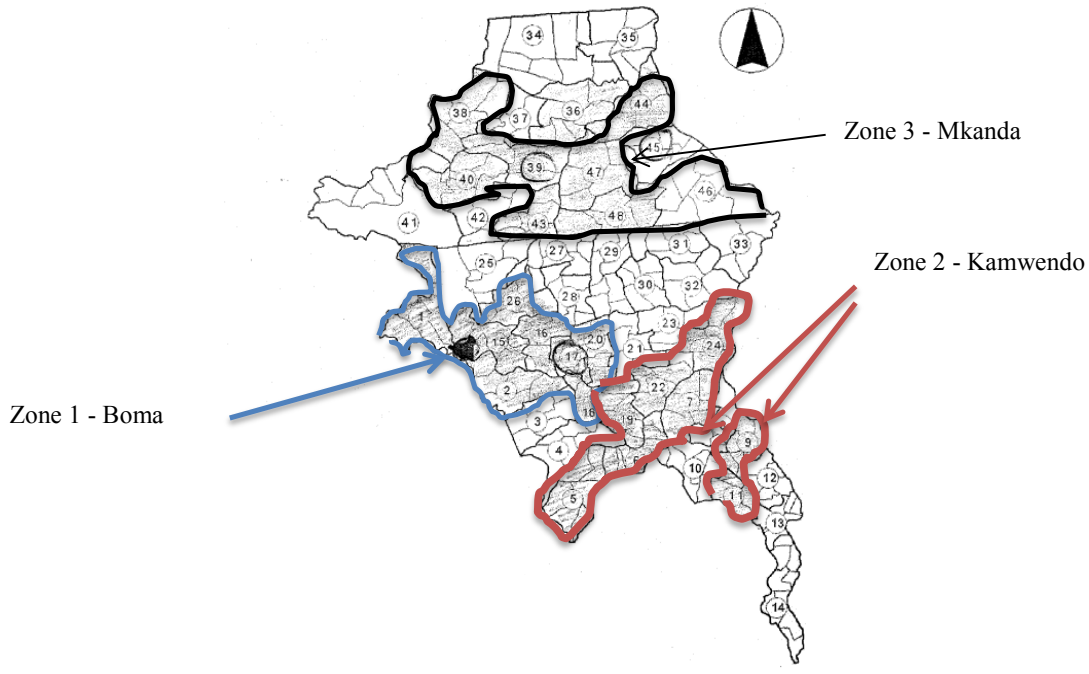
A sample size calculation was conducted to determine the number of women required to test the hypothesis that unintended pregnancies are associated with a higher prevalence of postnatal depression for the mother and the composite adverse pregnancy outcome of miscarriage, stillbirth, low birthweight and neonatal death for the baby. From data available for Malawi, both the maternal and the composite adverse pregnancy outcome were estimated to have a prevalence of 15% (22, 308-310). Based on my literature review and meta-analyses, and bearing in mind that those were unadjusted estimates, I chose a conservative effect size of a 25% relative difference in the outcomes between planned and unplanned pregnancies. This would mean that the prevalence of the adverse outcomes would be 13.6% in planned pregnancies and 17.0% in unplanned pregnancies. With 80% power (β), a significance level of 0.05 (α) and the estimated proportion of unplanned pregnancies being 41%[xv] (311) the sample size calculation indicated 3,737 pregnancy outcomes were needed. The full sample size calculation is in Appendix I. To allow for loss to follow-up between the antenatal and postnatal interviews this was rounded up to a minimum of 4,000 women to be recruited antenatally.

[xv] This estimate of unintended pregnancies is from the 2004 DHS, which were the data available at the time that I did the sample size calculations. The 2010 estimate was 45%, which would have meant a slightly smaller sample was needed (n=3658).

4.2 Selection of areas to be included in the research

Mchinji District, Malawi, was selected as the location for this research for the reasons described in section 1.6. For logistical and budgetary reasons it was not possible to include the whole of Mchinji District in this research. Based on demographic data available from the latest Demographic and Health Survey (DHS) (22) I estimated that there were about 20,000 births in Mchinji District each year. Allowing for a small number of women to be missed by the surveillance system and women who would not consent, I estimated that covering half of the district for six months should be sufficient to recruit 4,000 pregnant women.

Previous research in Mchinji divided the district into 49 geographical areas, each with approximately the same size population. I used Microsoft Excel to generate a list of random numbers between one and 49 and took the first 25 of these as the random sample of areas to be included in the research. I replaced duplicates in this list with the next unused random number listed. I then grouped these 25 clusters into three zones based on their location, shown in Map 4-1.



Map 4-1 Map of Mchinji District showing 25 included clusters grouped in to three zones

4.3 Recruitment and training of staff

4.3.1 Recruitment of data collectors

Based on their understanding of the research and the capabilities of potential field staff, MaiMwana Project monitoring and evaluation officers (MEOs) recruited twenty-five data collectors, one from each of the geographical areas that had been selected. Many data collectors had previously worked with the organisation conducting field interviews with women.

The MEOs were asked to preferentially recruit female data collectors given the nature of the research, the personal nature of some of the questions asked and to respect local sensitivities regarding the appropriateness of unknown men visiting women at their homes. Unfortunately this was not always possible as in some areas there was not an available woman whom the MEOs felt would be competent. Ultimately 19 female and six male data collectors were recruited. I monitored the male data collector's early data for adverse or unexpected consequences, such as higher refusal rates, but none were noted. Over the course of data collection, two female data collectors left and were replaced with one female and one male data collector.

The data collector's role was to visit the pregnant women in their area each month from the list that they were given (see description in section 4.5), invite them to participate in the research, obtain informed consent and conduct the antenatal and, subsequently, postnatal interviews. They met with their supervisor at least once a week to pass on the data.

4.3.2 Recruitment of project supervisors

Three project supervisors (hereafter 'supervisor') were required, one per zone. Advertisements were placed in national newspapers in January 2013 and over 150 applications were received. These were long listed by MaiMwana staff to 25 applicants and I shortlisted ten. I conducted the interviews with the MaiMwana Project manager and the Parent and Child

Health Initiative[xvi] (PACHI) Head of Projects in the PACHI office in Lilongwe in late January 2013.

The supervisors were responsible for eight to nine data collectors in their zone. They were expected to visit each data collector every week to collect data from him or her, as well as provide additional support as requested by the data collector or me. They submitted weekly reports to me detailing progress and problems in the data collection.

4.3.3 Training

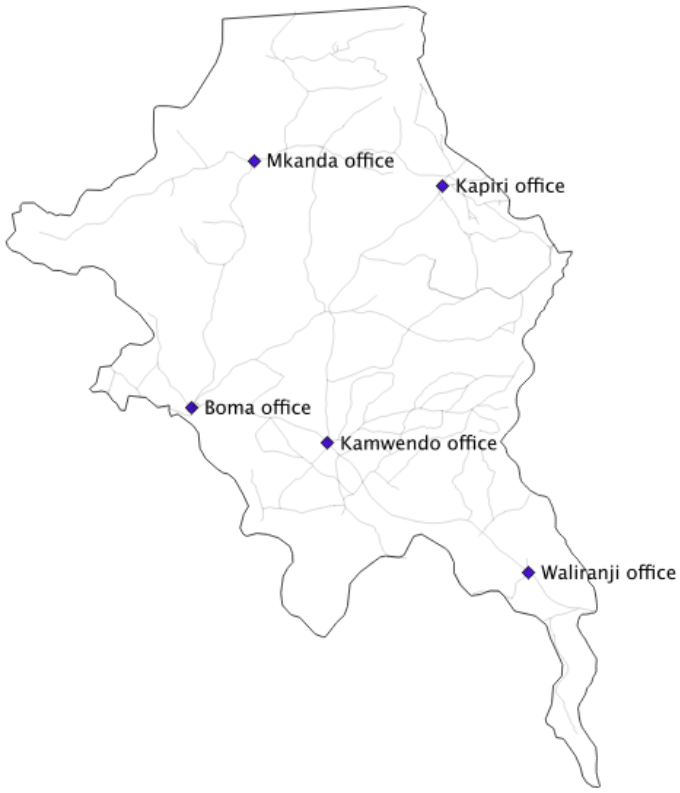
I designed and delivered a two-week residential training programme in February 2013. This covered all aspects of the research, from consent and confidentiality to depression and anthropometry, and included several days piloting the interviews, as shown in the timetable in Appendix J. Prior to the start of postnatal follow-up interviews, I delivered a two-day residential refresher-training course in late April 2013; the timetable is in Appendix K. I held centralised quarterly team meetings with all field staff of one to three day's duration throughout the project. At these meetings progress and preliminary findings were fed back to the data collectors, refresher training was conducted as necessary and there was time for feedback from the field and troubleshooting.

4.4 Surveillance system and identification of pregnant women

As part of on-going research into the effectiveness of the pneumococcal vaccine in Mchinji District there is a district-wide surveillance system. This is comprised of 1,064 key informants (KIs) covering all the villages in the district. Each KI has a village register that enumerates every household and every member of that household. In theory this means that each person has a unique identification number. Every month the KI reports on all the new pregnancies, births and deaths of women and children in their area using this unique identification number as well as names. The KIs are supervised by one of 50 enumerators who visit them every month to troubleshoot, provide guidance and to collect the last month's data. The enumerators are, in turn, supervised by one of eight MEOs who meet the enumerators several times a

[xvi] PACHI is MaiMwana's parent organisation.

month and collect the data from them. The MEOs are based in one of four MaiMwana nodal offices spread across the district (see Map 4-2). After checking and processing the data from the enumerators it is brought in to the main MaiMwana office in the Boma (the main town in Mchinji District) where the data team manually input the data from the paper forms into the Microsoft Access database.



Map 4-2 Location of MaiMwana Project offices in Mchinji District

The KI only becomes aware of a pregnancy either when the woman tells him or her or, more usually, once the pregnancy becomes physically obvious. In Malawi there is a culture of not talking about being pregnant until it is observable (and sometimes not even then). This is due to concerns about witchcraft or that the 'evil eye' may be put on the woman, resulting in an adverse outcome (personal observation). Because of this pregnancies are generally not notified until between the fifth and seventh months of gestation. This means that miscarriages or abortions occurring before this time are not picked up by the surveillance system and could not be included in my research.

Part of the rationale for conducting this research in Mchinji District was the existence of the surveillance system covering pregnant women. I planned to link my research into the surveillance system as shown in Figure 4-1. However, a download from the surveillance database in January 2013 of all the pregnant women who had been notified through the surveillance system in the last seven months had less than half the number that would be expected in one month. This alerted me to problems with the surveillance system which I took steps to address (detailed in Appendix L).

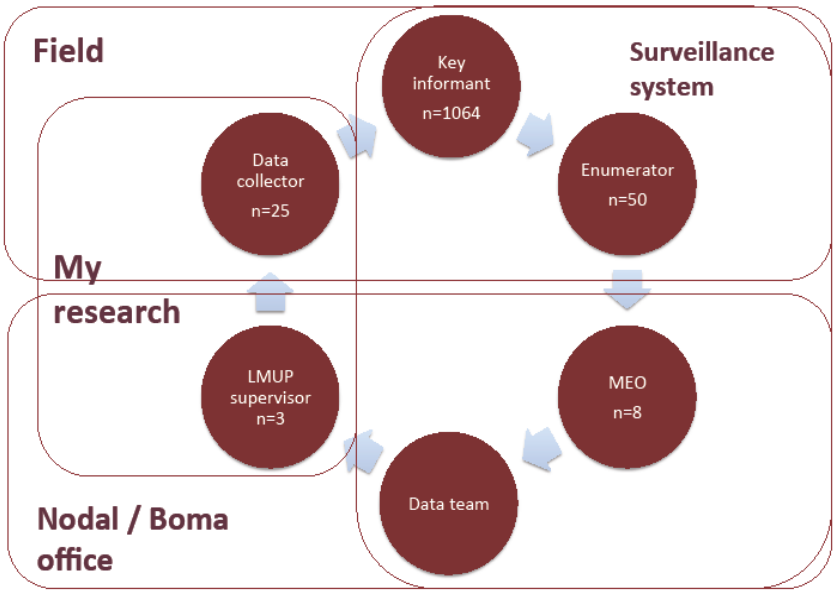


Figure 4-1 Relationship of data collection for this research to existing MaiMwana surveillance system

A series of briefing meetings were held in late February and early March 2013 with all the KIs in the research area. At these meetings the purpose of the research was explained to them and the process for and importance of notifying pregnancies was reviewed. Following these meetings all data collectors from this research spent two weeks with the KIs, visiting all the villages included in the research area and working with the KIs to identify currently pregnant women. Data collection began on 8th March 2013.

Despite improvements in the surveillance system, recruitment remained slower than anticipated. There were two main reasons for this. Firstly, the

fertility rate in the district had fallen and was lower than the figure reported in the 2010 DHS that I had used to estimate the number of births. MaiMwana Project estimates in early 2013 suggested that about 15,000 births were now expected district-wide per year. Secondly, late notification of pregnancy and delays in the flow of data meant that by the time the women were visited a larger than expected proportion had already given birth and were no longer eligible for recruitment.

My own field visits and reports from the data collectors showed that there were pregnant women in the villages who were willing to be interviewed. Most of them had been reported by the KIs but their information had not yet reached the data collectors. From August 2013 I introduced a parallel recruitment system, with the support of the MEOs and enumerators, to enable the data collectors to supplement the surveillance system with pregnant women identified in the field.

4.5 Data collection process

Once a month from March 2013 to December 2013 a list of pregnant women was downloaded from the surveillance system database and given to me. I then 'cleaned' the list by removing women who had already been visited, women who could no longer be pregnant given their calculated gestation or women who were not in my research area. The list included the name of the woman's village and key informant, her own name and the name of the head of her household, as well as her unique identification number.

From this I generated a 'pregnancy notification sheet' for each data collector each month. I grouped the pregnant women by village to reduce travel time for the data collector and listed them in order of most pregnant women first to reduce the risk of them having already delivered by the time of the visit. An anonymised example of the pregnancy notification sheet is shown in Appendix M. The data collector completed this sheet to record which women had been visited and when, or why they had not been interviewed. Recruitment took place from 8th March – 23rd December 2013.

The supervisors updated their electronic versions of these sheets during their weekly visits with the data collectors to monitor progress. They then added

in ‘estimated delivery date’ (EDD) from the data and used a formula I had pre-set into their electronic sheets to calculate the date after which the woman should be revisited for the postnatal interview. This was calculated as the EDD plus 35 days. Using this information, the supervisors generated postnatal visit sheets for each data collector each month. An example anonymised postnatal visit sheet is shown in Appendix N.

After a few months of postnatal data collection I crosschecked the postnatal visits that had been done with those that should have been done on the basis of the EDD and found that a large number were missing. Some of these were simply due to the fact that the EDD was very inaccurate so that women were still pregnant when the data collector returned to do the postnatal interviews. However, some were due to supervisor error, i.e. having missed these women off the postnatal visit sheets. Every month I then generated a list of ‘missing postnatal visits’ for each supervisor to keep track of. When there was no improvement after further training of the supervisors I took over the generation of the postnatal visit sheets to reduce the risk of missing women and improve the timeliness of follow-up. Postnatal follow-up was completed in July 2014.

4.6 Data collection tools

Samsung Galaxy Mini mobile phones were used to collect the data. I programmed the research questionnaires onto the phones using CommCare ODK software. The data were downloaded from the mobile phone to a server by the supervisors every week. I taught the supervisors to use their project laptop to set up a local Wi-Fi network with an Internet signal from a dongle. I programmed the phones to automatically link to that Wi-Fi network and submit the data through it. A significant advantage of this system was that the data were uploaded to the CommCare ODK server and I could download these data and check on progress and errors from wherever I was. Collecting data electronically also meant I could collect Global Positioning System (GPS) co-ordinates for every interview. This was used to verify that the data collectors were visiting the areas they were supposed to, to map the locations of the interviews and to calculate the distance to the nearest health

facility for each woman. I used the open-source software QGIS (formally Quantum GIS) to do this (31).

My research was one of several using different methods of electronic data capture at MaiMwana Project at the same time. My colleagues and I took advantage of this to write a paper (on which I am second author) comparing our experiences and offering advice to others considering the use of electronic data capture. This has been published in Global Health Action (312) and is included in Appendix O.

4.6.1 Questionnaires

I developed the antenatal and postnatal questionnaires using the MaiMwana questionnaires from the women's group research as templates. I added questions according to the aims of my research and the findings of my literature review on factors associated with pregnancy intention and maternal and neonatal health outcomes. Additions included the London Measure of Unplanned Pregnancy and DHS questions on pregnancy intention, the Self-Reporting Questionnaire (SRQ) for assessing maternal mental health, a set of questions developed to assess previous experience of depression, DHS questions on future fertility intentions and ideal family size, the Abuse Assessment Screen for intimate partner violence and a question on food security. The food security question was added into the postnatal questionnaire partway through data collection because a relationship was observed between food security and maternal mental health status in another area of Malawi and it could therefore be a potential confounder (Dr Stewart, personal communication).

Most data were collected by asking the mother directly, but some data were collected from, or verified by, either the mother's or child's 'health passport' - the patient's hand-held notes. These included, for example, the number of antenatal attendances, the child's date of birth, birthweight and immunisation status.

I developed separate questionnaires for women who did not consent to take part in the research at all, women who did not consent postnatally having completed the antenatal questionnaire and for maternal deaths. Women

who declined consent antenatally were asked to answer some socio-demographic questions. The aim of this was to have some information on the women who refused to take part to compare them to the responders. Women who declined to complete the full postnatal interview were offered the option to complete a shorter version. It was intended that those who declined this would be asked if they could just tell us the outcome of the pregnancy but unfortunately I made a coding error in the postnatal no consent questionnaire that meant that this did not happen.

The complete English versions of the antenatal and postnatal questionnaires are included in Appendix P and Appendix Q respectively but more detail on some key questions follows.

4.6.1.1 Maternal mental health status

The woman's mental health status during and after pregnancy was assessed using the validated Chichewa version of the World Health Organization's (WHO) Self-Reporting Questionnaire (313). The WHO developed the SRQ as a cross-cultural screening tool for common mental disorder, a mixture of depressive, anxious and somatic symptoms. It has been successfully used in a range of settings such as Ethiopia and India (314, 315). It consists of 20 simple yes/no questions (shown in Table 4-1) covering physical and psychological symptoms; each 'yes' answer indicates the presence of a symptom and attracts a score of one point. The 'yes' answers are summed giving a range of possible scores from zero to 20 with a higher score indicating a higher likelihood of the presence of common mental disorder. Women scoring more than seven screen positive for minor or major depression according to Stewart et al.'s validation in Malawi (313).

WHO Self-Reporting Questionnaire
Do you often have headaches?
Is your appetite poor?
Do you sleep badly?
Do your hands shake?
Do you feel nervous, tense or worried?
Are you easily frightened?
Is your digestion poor?
Do you have trouble thinking clearly?
Do you feel unhappy?
Do you cry more than usual?
Do you find it difficult to enjoy your daily activities?
Do you find it difficult to make decisions?
Is your daily work suffering?
Are you unable to play a useful part in life?
Have you lost interest in things?
Do you feel that you are a worthless person?
Has the thought of ending your life been on your mind?
Do you feel tired all the time?
Do you have uncomfortable feelings in your stomach?
Are you easily tired?

Table 4-1 The 20 questions of the Self-Reporting Questionnaire for Common Mental Disorder

I chose the SRQ for several reasons. Most importantly, it had already been validated in the Chichewa language in a population of postnatal women in Malawi (313). Although the SRQ is not specific to postnatal depression it was found to be acceptable in this postnatal Malawian population, indicating it was highly appropriate for use in my research. The Edinburgh Postnatal Depression Scale (EPDS) was specifically designed to screen for postnatal depression but at the time had not been validated locally. It has now been tested in an antenatal population in Malawi (316). The EPDS is conceptually more complex than the SRQ; the SRQ questions are fairly simple yes/no questions whereas EPDS responses are on a Likert scale. Colleagues' previous experience was that Likert scales were not well understood locally. Another consideration was the relatively low levels of education of the data collectors and the need for them to be able to understand and explain the questions. Following discussion with Dr Stewart, a consultant psychiatrist

with extensive experience in Malawi and the person who validated both the SRQ and subsequently the EPDS, I decided that the SRQ was likely to be better understood, and therefore answered, than the EPDS. This was supported by the findings of a study comparing the use of the SRQ and the EPDS in Pakistan (317).

One of the SRQ questions asks: 'Has the thought of ending your life been on your mind?' If a woman answered 'yes' to this question she was asked three additional questions about suicidal ideation after the end of the SRQ questions. These questions asked whether she had these thoughts all of the time, if she had thought of a way to commit suicide and whether she had actually tried to commit suicide.

4.6.1.2 Assessment of previous depression

In the absence of a validated tool for assessing previous depression I developed a set of four questions in collaboration with Dr Stewart. This was used in the antenatal interview to screen for possible episodes of depression in the year before pregnancy. The questions are shown in Table 4-2.

Question	Description
1	Over the year before you became pregnant, did you have times where you felt down, depressed, or hopeless? If yes, did these episodes last for more than two weeks?
2	Over the year before you became pregnant, did you have times where you felt little interest or pleasure in doing things? If yes, did it last for more than two weeks?

Table 4-2 Screening questions for possible episodes of depression prior to pregnancy

Responses to these questions were used to categorise women as to the extent of possible previous depression, as shown in Table 4-3, with a higher categorisation indicating a greater likelihood of previous depression. It should be noted that this is only indicative of possible previous depression and is not intended to be diagnostic.

Category	Description
0 – None	Answered 'no' to both questions about previous episodes indicating possible depression
1 – 1 or 2, < 2 weeks	Answered 'yes' to one or both questions about previous episodes indicating possible depression but said that these episodes had never lasted more than two weeks
2 – One ≥ 2 weeks	Answered 'yes' to either question about previous episodes indicating possible depression and said that these episodes had lasted more than two weeks
3 – Both ≥ 2 weeks	Answered 'yes' to both questions about previous episodes indicating possible depression and said that these episodes had lasted more than two weeks

Table 4-3 Categorisation of previous experience of depression

4.6.1.3 Intimate partner violence

Intimate partner violence (IPV) is a major public health problem globally and Malawi is no exception. IPV is usually, but not always, violence conducted against women generally by their partner or family members. It is defined as *'any act of gender-based violence that results in, or is likely to result in, physical, sexual, or psychological harm or suffering to women, including threats of such acts and the coercion or arbitrary deprivation of liberty whether occurring in public or in private life'* (318).

Malawi has recognised IPV as a severe impediment to poverty reduction, and particularly to HIV prevention efforts. Consequently Malawi has ratified the relevant international conventions, is signed up to regional protocols and declarations on the rights of women and the elimination of violence and enacted the Prevention of Domestic Violence Act in May 2006 followed by the launch of the National Response to Combat Gender-Based Violence, 2008-2013 (319). According to this Act, IPV *'includes physical, sexual, emotional, psychological, or financial abuse committed against a spouse, child, any other person who is a member of the household, dependent or parent of a child of that household'* (319).

Although condemned at the level of legislation, Malawi's cultural traditions have long condoned most forms of IPV (22). They are seen as private issues that should not be interfered with. Combined with weak implementation, this has meant that there has been little progress on the issue, with most violence against women going unreported. However, the Malawi DHS attempted to collect data in 2004 (311) and again in 2010 (22). In 2010 this showed that between one in five and one in three women had ever experienced physical violence, depending on their age. In over three-quarters of cases the perpetrator had been their partner. Similar percentages of women had ever experienced sexual violence and 15% of women's first sexual experience had been forced against their will. 6% of women had experienced physical violence during pregnancy and this was more common in adolescents (9.4%).

Questions on IPV were included because it has been shown to be associated with unintended pregnancy and with adverse pregnancy outcomes (176, 306, 307), as described in section 3.3.5.9. It was therefore an important covariate to be considered in this research.

A recent systematic review identified and compared the most common psychometrically validated IPV screening tools (320). Of the 21 identified the only one created to detect abuse against pregnant women was the Abuse Assessment Screen (AAS) and this was therefore the one I selected.

The five AAS questions are shown in Table 4-4. A positive response to any question indicates abuse. Question five was only asked if she had responded positively to any of the first four questions.

Question	Description
1	Have you ever been emotionally or physically abused by your partner or someone important to you?
2	Within the last year, have you been hit, slapped, kicked, or otherwise physically hurt by someone? If yes, by whom? How many times?
3	Since you have been pregnant, have you been hit, slapped, kicked, or otherwise physically hurt by someone? If yes, by whom? How many times?
4	In the last year, has anyone forced you to have sexual activities? If so, who? How many times?
5	Are you afraid of anyone you listed above?

Table 4-4 The five questions of the Abuse Assessment Screen

A limitation of this choice is that it has not been formally validated in the Chichewa language. However, to my knowledge there is no validated Chichewa IPV screening tool. Formal validation of the AAS fell outside the scope of this research. Instead, three native Chichewa speakers translated the questions and one version was agreed which was back translated and tested on the data collectors during training. The AAS has been used extensively with poor women in the USA (320, 321) and has also been evaluated in Brazil and Sri Lanka (322, 323). Whilst these are clearly very different settings to Malawi it provides some reassurance that the AAS may be suitable.

4.6.2 Examination

In addition to the questionnaires, several anthropometric measurements were taken. The mother's height and mid-upper arm circumference were measured at antenatal interview and the baby's length and weight were measured at postnatal interview. These data were used in the imputation of the missing birthweight data.

4.7 Ethical issues

4.7.1 Local approval

Approval to conduct this research in Mchinji District was given by the District Health Officer, Dr Chimwemwe Banda, in January 2013 and he was updated on progress every quarter. A briefing meeting was held with the District Executive Committee in early February 2013.

4.7.2 Consent

As part of the two-week training at the start of the project, I trained the data collectors on the concept, importance and principles of informed consent through a combination of teaching, discussion and role-play. Written informed consent, by thumbprint where necessary, was obtained from all participants before starting the interview. Consent forms were stored in a lockable filing cabinet in the main office and the woman was given a copy of the information sheet and her consent form to keep. The information sheets and consent forms for all parts of this research are included in Appendix R.

Only pregnant women aged 15 and over were eligible for inclusion in the research due to the complexities of gaining truly informed consent from those below 15. The data collectors were trained to pay special attention to gaining informed consent from those aged 15-18. All questions were optional and women had the right to withdraw from the research at any time for any reason.

4.7.3 Confidentiality and anonymity

The importance of confidentiality in all aspects of data collection was emphasised to the data collectors throughout the training.

While the UK Data Protection Act does not apply to Malawi, data were handled in accordance with it and with the MaiMwana Data Policy. All data were anonymous, with antenatal and postnatal interviews linked by the woman's unique identification number. The data were collected on password-protected mobile phones and were in an encrypted form on the mobile phone. The only place where there was person identifiable data was on the pregnancy notification and postnatal revisit sheets, as clearly it is

necessary for the data collectors to know the name of the woman they are trying to locate. Training was given on the importance of protecting this person identifiable information while in the field. All hard copies were returned for storage in the lockable filing cabinet in the main office, while all soft copies were encrypted using TrueCrypt software.

4.7.4 Incentives

None of the participants in this part of research received any incentives or compensation for taking part.

4.7.5 Safety

The research was approved by UCL following a risk assessment. I took appropriate preventative measures against infectious diseases (malaria prophylaxis, pre-travel immunisations and sleeping under an insecticide treated bed net). I had a mobile phone with emergency contact numbers and made field visits accompanied by other members of the team. These visits were conducted during the dry season to reduce the risks from flooding and poor road conditions.

The motorbikes procured for the supervisors were brand new and were regularly serviced. Protective equipment, including helmets, gloves and boots, was provided.

4.7.6 Adverse effects

No adverse effects arising directly from participation were anticipated during the course of this research but all participants were given contact details for MaiMwana Project and for me should this have occurred. To my knowledge this was not taken up by anyone. Procedures were put in place for women who were identified as at risk of IPV or mental health issues, as discussed in the next section.

Two of the supervisors experienced a total of three minor motorbike accidents during the 18 months of fieldwork. No serious injuries resulted from these and the project covered the costs of treating the minor injuries and repairing the motorbikes.

4.7.7 Management of women where concerns were raised

Both the antenatal and postnatal questionnaires asked the SRQ, a screening tool for anxiety and depression. Where women scored more than seven points there was a suggestion that they may be suffering from mental illness. In this case, or if the woman answered the question about suicidal thoughts in the affirmative, I had programmed the phone to alert the data collector. This prompted the data collector to advise the woman that she may be depressed and she should attend a health facility for help. To raise healthcare worker's awareness and skills in the management of maternal mental health issues I organised a two and a half day training course for a selection of healthcare workers from across Mchinji District. A British psychiatrist based in Blantyre and Zomba delivered this training with a Malawian psychiatric nurse and a psychologist. The timetable is shown in Appendix S.

Women who screened positive on any of the Abuse Assessment Screen questions were given the name of several local organisations that could help them.

4.8 Chapter summary

In this Chapter I have described how the cohort was established, including sample size calculations, the selection of areas for inclusion in the research, the recruitment and training of the team, the identification of pregnant women for interview from the pre-existing surveillance system and the development of the data collection system and questionnaires. Ethical issues and the process for gaining local approvals were discussed. The next Chapter will explain the data management and cleaning processes and the analysis plan.

Chapter 5 Data management and analysis

The last Chapter explained how the cohort was established and data were collected. In this Chapter I describe the data management processes, including validation and cleaning, the procedures for handling and imputing missing data and the calculation of my measure of socio-economic status. Finally, I explain the methods used in the analyses of the determinants of pregnancy intention and the relationships between pregnancy intention and maternal and neonatal outcomes.

5.1 Data management

5.1.1 Data cleaning

In the first few weeks of data collection I paid close attention to data quality. On the basis of observed errors I made changes to the programming of the questionnaire, fed back errors to the supervisors and data collectors and conducted refresher training on common errors and misunderstandings. Repeating the data checking exercise showed that there was a marked reduction in the rate of errors made. This positive feedback was shared with the supervisors and data collectors.

Data checking continued throughout the whole data collection period. Supervisors reported the issues they identified and progress in resolving them each week and every month I thoroughly checked all the data and sent queries to the supervisors to investigate. Where possible data errors were corrected by going back to the field for verification.

5.1.2 Data validation

Using the features available in CommCare ODK I programmed a large amount of data validation to be performed in real time during data collection. This included automated skip patterns, valid ranges for numerical values and calculations to crosscheck the answers women gave. These measures reduced the possibility of an impossible value being entered but cannot entirely prevent an incorrect value being entered simply due to human error.

I also set all questions to require an answer, which could be ‘don’t know’ or ‘no answer’, to reduce missing data.

I also utilised other features unique to electronic data collection in data validation. For example, from the time stamps on the interviews I noticed that one of the data collectors was conducting antenatal interviews much more quickly than others, raising concerns that she was rushing the women or even making the data up. However, she had been one of the best data collectors during the training and she had extensive previous experience of interviewing women using a similar questionnaire, so it was plausible that she simply was quicker than the other data collectors. The issue was discussed with her and she insisted that she was interviewing women correctly. To verify this I mapped all the interviews she had done using the GPS coordinates, which confirmed that she had been to the places where the women lived. Her supervisor then visited the women she was supposed to have interviewed to check that they had been visited, which they had. Finally, the supervisor visited women with her, observed her conducting interviews and gave her feedback on her interview technique.

I continued to clean and validate the data in Stata during the preparation of the data for analysis.

5.1.3 Data preparation

Data downloaded from CommCare ODK is opened in Microsoft Excel but I did all the data management in Stata. This included reformatting data from long to wide, merging datasheets so that all the data for each woman’s antenatal and postnatal interviews were in one row of one data file and appending the data from the postnatal no consent and maternal death interviews. I recoded and labelled variables and categorised them where appropriate. I separated out the responses to multiple-choice variables and created dummy variables. Text responses had a mixture of English and Chichewa answers; I reviewed these manually and then coded them into dummy variables.

I compared variables to assess consistency and where I identified inconsistencies while the data collectors were still employed these were sent

back to the field for verification. After this time, or where it had not been possible to verify the data, I recoded outlying or inconsistent values as missing.

I paid particular attention to the anthropometry data for the child since I planned to use this to impute the missing birthweight data. I calculated z-scores[xvii] for weight-for-age, length-for-age and weight-for-length for the data collected at the postnatal interview using the 'zanthro' add-on for Stata and the World Health Organization 2007 Child Growth Charts (324). I also calculated z-scores for weight-for-age at birth and compared them with the z-scores for weight-for-age at postnatal follow-up. In this way babies whose two measurements suggested significant weight gain or loss were identified, but those who were consistently larger or smaller were not (as it is less likely that both measurements would be incorrect). The data collectors were asked to re-measure these babies and to confirm their birthweight from the health passport where possible. In addition I used the blocked adaptive computationally efficient outlier nominators (BACON) algorithm that identifies outliers in multivariate data (325, 326) to identify outliers when weight, length and age were considered together. These were returned to the field for verification or recoded to missing.

5.1.4 Collinearity

A small number of variables were collinear[xviii] and had to be managed in a way that accounted for this. Women's living arrangements were highly correlated with marital status; 99% of unmarried women were not living with their partner and 93% of married women were living with their partner all or most of the time. Marital status was chosen in preference to living arrangements as this is a more commonly used variable in these analyses.

To account for collinearity between the variables for whether this was the woman's first birth (primigravida) and birth interval in the multivariate

[xvii] A z-score is the number of standard deviations an observation is from the mean. For example, in anthropometry a z-score of more than -2 for height-for-age would indicate that that child is two standard deviations below the average height for a child of that age in the reference population. This would mean that the child is stunted.
[xviii] Variables are collinear when they are highly correlated, which essentially means that one can be predicted from the other.

analyses I combined these two variables, as was done by Ikamari et al. (248). Instead of a binary yes/no variable for primigravida and a separate variable for the time since the last birth, if there had been one, I created a new categorical variable with women experiencing their first birth acting as the baseline and time since last birth grouped into less than two years, two to three years and more than three years.

I wanted to include miscarriages and stillbirths in the multivariate analysis of postnatal depression as they were potentially important factors, as described in section 3.3.3.6. However, since women who had had a miscarriage were not asked questions about the delivery and women who had had a stillbirth were not asked questions about the postnatal health of the baby, this caused a lot of women to be dropped from the analysis due to missing data. After discussion with Dr Copas, I first created a variable where miscarriage was equal to zero and no miscarriage was equal to one. Then for each delivery variable I changed the value for women who had miscarried from 'missing' to the baseline category of the variable. By making these changes I was able to see the effect of the delivery variables on postnatal depression in women who had not had a miscarriage. The effect of miscarriage presented (rather than of no miscarriage as I reversed the coefficient from the model) can be interpreted as a comparison of women with a miscarriage with women who did not have a miscarriage and are in the reference category for each delivery variable. The same process was followed for stillbirths and postnatal variables.

5.2 Missing data

5.2.1 Prevention of missing data

To reduce the amount of missing data, I worked to ensure that the questionnaire was well designed and used questions that were known to be acceptable, as they had previously been used in the area during the women's group research (327). I gave the data collectors in-depth training where we went through each question discussing what it meant and why we were asking it to ensure that they understood the value of every question and could explain the question to the woman if she asked.

Sensitive questions, such as those about people's sex lives, often have high rates of missing data. In recognition of this I prefaced these questions with assurances and reminders about the confidential nature of the data, in addition to the information provided during the consent process. I also predominantly had female interviewers to reduce any embarrassment in revealing such personal information to a member of the opposite sex. The Chichewa translation of the LMUP had been tested on women using cognitive interview techniques to check it was understandable and acceptable as part of the validation process (Chapter 6) and all the data collectors were able to practice interviewing both on each other and on other women as part of their training.

5.2.2 Management of missing data

There are multiple potential methods for handling missing data, ranging from simple case wise deletion to complex multiple imputation. Case wise deletion, removing from the analysis any cases where there are missing data and using only those cases with complete data, is a common and simple method. This can result in a considerable loss of statistical power, wastes much of the information that has been collected and leads to biased estimates if the data are anything other than missing completely at random (see Appendix T for further discussion of missing data types).

A simple mean imputation can be done for continuous variables where the missing values are all replaced with the mean of the non-missing values for that variable. Alternatively, a regression mean can be calculated where other relevant variables are also taken into account. The major limitation of these methods is that they reduce the variability (because all the 'new' values are the same – the mean), leading to falsely increased precision.

These methods are being replaced by multiple imputation methods that try to take into account the fact that the data is imputed and is not 'real' by estimating each missing value based on the observed values for other cases in the dataset. By assuming that the observed values in the dataset define a distribution with parameters that can be estimated from the dataset it can be seen that random draws from this distribution can be used to impute the

missing values. This estimation is repeated through an iterative process until the parameters of the distribution no longer change, i.e. there is convergence. A multiple imputation model must include all the variables of relevance in the imputation or that are included in the final multivariate analysis model, including the outcomes, confounders and cluster identifiers.

5.2.3 Managing missing data in the London Measure of Unplanned Pregnancy

It is not possible to calculate a woman's total LMUP score if there is a missing answer for any question. Therefore the imputation of missing data must be considered if we do not wish to drop that woman from the analysis completely. Mean imputation is recommended and can be performed if at least half of the questions have been answered (8). As noted above, mean imputation can reduce the variability of the variable leading to falsely increased precision. However, if the amount of missing data is small this impact is negligible.

There was less than 0.5% missing data on the antenatal LMUP. Seventeen of the 4,244 women were missing one answer to the LMUP questions and one woman was missing two answers. Given the very small level of missing data I considered it appropriate to impute these missing values using mean imputation.

5.2.4 Managing missing data in the Self-Reporting Questionnaire

The Self-Reporting Questionnaire (SRQ) score, as an indication of postnatal depression, was the main maternal outcome of interest. Like the LMUP, the SRQ requires missing data to be imputed before a score can be calculated. There is no specific guidance on how to do this for the SRQ but in light of discussions with Dr Stewart, who validated the SRQ in Chichewa, I considered mean imputation.

Again the level of missing data was very low; only 51 women (1.2%) were missing one or more answers on the antenatal SRQ. Most of these were missing just one answer (n=44), five were missing two answers, one was missing three and one was missing four answers. On the postnatal SRQ there were 39 women (0.9%) missing one or more answer; 33 were missing

one, five were missing two and one was missing five answers. I therefore calculated these missing values using mean imputation.

5.2.5 Managing missing birthweight data

Birthweight is part of my primary neonatal outcome of interest but from the outset I expected to have a high proportion of missing data for this variable. In the 2010 DHS, Mchinji District was reported to have birthweight recorded on 69.1% of births in the last five years, or 30.9% missing (22). In my data the level of missing data for birthweight was slightly lower at 22.0% (872 missing out of 3,957 live or stillbirths). Babies that were stillborn or who were born at home or in transit were significantly less likely to have been weighed at birth. This suggests that the data were missing at random, as whether or not they were missing can be explained by differences in other variables in the data and is unrelated to the unobserved value itself.

Discussions with Professor Andrew Prentice of the London School of Hygiene and Tropical Medicine led me to collect anthropometric data on the babies at the postnatal visit, as well as birthweight where it had been recorded in the health passport, and to use this and other data to create a multiple imputation model to impute the missing data. In addition to the anthropometry measures on the child at the postnatal visit, the imputation model contained variables that were shown to be associated with pregnancy intention (described in section 3.3.4), such as mother's age and education level, and factors known from the literature to be associated with birthweight (described in section 3.3.2.7), such as maternal height, birth order and whether it was a multiple birth. I also included antenatal behaviours that could have influenced birthweight, such as taking iron/folic acid and preventative measures for malaria, and factors that could be associated with whether or not birthweight was measured, such as place of delivery, person delivering the baby and stillbirth.

As some of these variables had small amounts of missing values themselves these were simultaneously imputed so that as many of the missing birthweight values could be imputed as possible. I used a multivariate normal regression model, using an iterative Markov chain Monte Carlo

method. The full multiple imputation model is shown in Appendix U. The imputed birthweight data were used in all subsequent analyses involving this variable.

5.2.6 Other missing data

For most of the other variables collected, the rates of missing data were very low and so no imputation was undertaken. If values had been imputed in the birthweight imputation these were not used in the analysis as there were such low levels of missing data there would have been no added value in doing so.

However, the measure of how clean the delivery was (composed of hand-washing and use of gloves by the person delivering the baby) had 23.4% missing data, which is a significant amount. The cleanliness of the delivery was not hypothesised to be a key factor in any of the analyses and given its correlation with place and person of delivery may not add a significant amount of information. Therefore, clean delivery was not considered for inclusion in the multivariate analyses but was described in the univariate analysis.

5.3 Principal components analysis of socio-economic status

The socio-economic status (SES) of the household is an important determinant of the health of the household and a potential confounder of the relationship between pregnancy intention and maternal and neonatal health outcomes. Common ways to assess SES include measuring household income or expenditure or collecting data on variables that reflect living standards, such as the characteristics of the house, access to utilities and durable assets owned by the household, which are known as asset-based measures (328). Given the greater complexity of assessing household income or expenditure and the predominance of subsistence farming across Mchinji District that would limit the value of such an approach, I decided that an asset-based measure of SES was preferable.

In recent years asset-based measures have increasingly been used in a variety of settings to assess household SES, including by the World Bank

(329). To convert the data collected in multiple variables into a single variable measuring household SES multivariate statistical approaches, such as principal components analysis (PCA), have been used and are widely accepted (330-332). This is the same method that I used in the validation of the Chichewa LMUP (described in section 6.1.1) and is a way of reducing the number of variables into a smaller number of 'components'. For example, in the Chichewa LMUP validation, the six LMUP questions were reduced to a single component with an Eigenvalue greater than one by the PCA. In an asset-based SES analysis, where a larger number of variables are involved, it is normal to have more than one component with an Eigenvalue greater than one. Each component represents a different dimension within the data but the first component explains the largest amount of the variation in the data, with each subsequent component explaining additional but less variation (328). The first component is therefore used as the measure of household SES (332, 333). The methodology and results of the development of the asset index are described in detail in Appendix V. The distribution of SES score from this PCA is shown in Figure 5-1 below. For use in analysis this was grouped into quintiles.

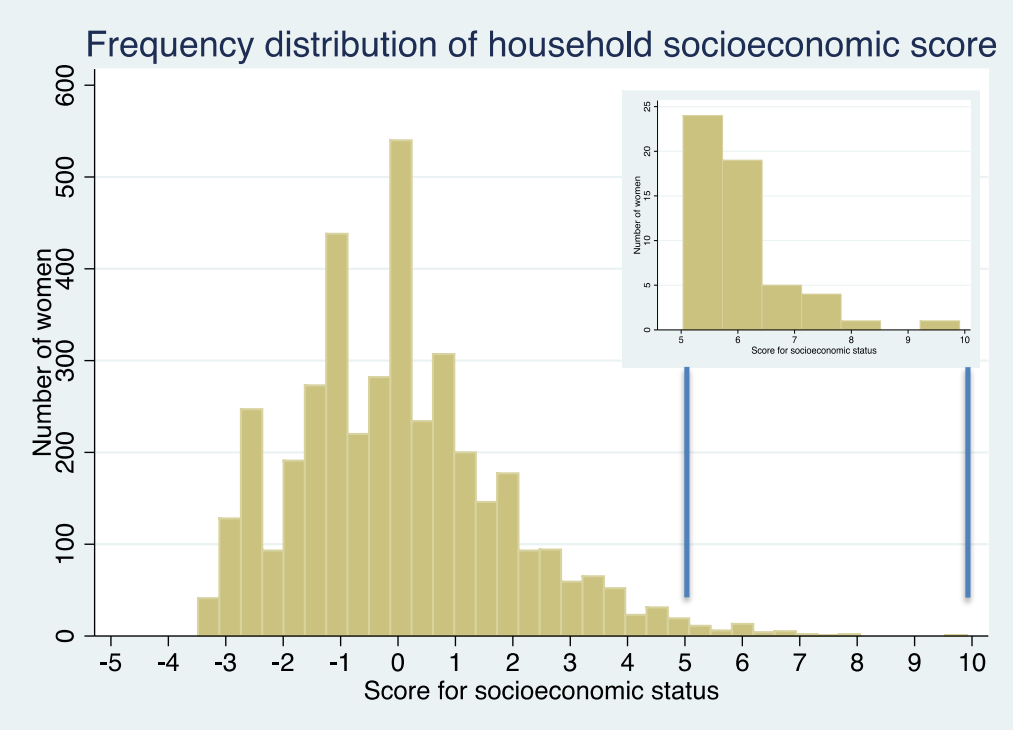


Figure 5-1 Frequency distribution of household score for socio-economic status

Using principal components analysis of household assets and structure in a setting such as Mchinji District can prove challenging. There is much homogeneity in the construction of houses, similar access to water and sanitation facilities and little variation in the range of assets owned. This lack of variability can lead to two well-known problems: truncation and clumping (328). Truncation is where there is a reasonably even distribution of SES but over a narrow range. This can make it hard to distinguish between socio-economic groups such as the poor and very poor. Clumping, on the other hand, is where households are grouped together in a small number of clusters. A previous PCA in Mchinji District resulted in 80% of households clumped in the lowest socio-economic group with an SES score with a range of about five. It is not clear which variables were included in that PCA but, with a range of 13.4 (from -3.28 to 9.91) and no obvious clumping, the current PCA would seem to be an improvement and is acceptable for use as a measure of SES in this research.

5.4 Methodology for the analysis of the determinants of pregnancy intention

The analysis of the determinants of pregnancy intention followed three stages. First, a description of the women interviewed antenatally, second, a univariate analysis of factors potentially associated with pregnancy intention and, third, the development of a multivariate model of the determinants of pregnancy intention in Mchinji District.

5.4.1 Descriptive analysis

The descriptive analysis explains the recruitment of pregnant women into the cohort and reasons for non-recruitment. I assessed the socio-demographic profile, obstetric and psychiatric history of the women recruited antenatally using frequencies, percentages, means and medians. The relationships between some variables were tested through stratification, using two-sided t-tests or chi-squared tests as appropriate. I mapped the location of all the antenatal interviews using QGIS software (31). I also used the GPS data to calculate the distance to each woman's nearest health facility.

I calculated the responses to each question of the London Measure of Unplanned Pregnancy and, after imputation of missing data, the distribution of LMUP total score. I compared the LMUP distribution in Mchinji District with the distribution in the UK using a two-sided chi-squared test.

5.4.2 Univariate analysis

I developed the choice of factors potentially associated with intention on the basis of the literature discussed in section 3.3.4. I used the full range of the LMUP score, from zero to 12, in the analysis. Due to the non-Normal distribution of pregnancy intention I used non-parametric tests.

To determine the choice of test I considered the hypothesised relationship between each variable and pregnancy intention. Where the hypothesised relationship was that the LMUP score would gradually increase or decrease across the categories of a continuous or ordered categorical variable, the Kendall's tau (a rank correlation) was used. Kendall's tau was also used for binary variables. Kendall's tau was used in preference to the better-known Spearman's rank correlation as its statistical properties are considered to be better (p350) (334).

Where the variable was categorical or the LMUP score was not expected to increase or decrease consistently across the categories of an ordered categorical or continuous variable, the Kruskal-Wallis test (a one-way analysis of variance) was used. In order to do the Kruskal-Wallis test some of the continuous variables had to be grouped. The grouping was done according to the hypothesised relationship and these variables remained categorical throughout the analysis. The variables considered, their hypothesised relationship with pregnancy intention and the test used is shown in Table 5-1.

I also did univariate linear regressions for the effect of each variable on pregnancy intention. These were compared with the results from the basic analysis and provide the unadjusted coefficients for comparison with the multivariate regression.

Variable name and type	Hypothesised relationship	Univariate analysis
Socio-economic status – ordered categorical	Higher pregnancy intention with increasing socio-economic status	Kendall's tau
Mother's age – ordered categorical	Lower pregnancy intention below 18 and over 30 years	Kruskal-Wallis
Father's age – ordered categorical	As above but possibly not so strong a relationship	Kruskal-Wallis
Mother's education level – ordered categorical	Higher pregnancy intention with increasing education	Kendall's tau
Father's education level – ordered categorical	Higher pregnancy intention with increasing education	Kendall's tau
Marital status – binary	Higher pregnancy intention in married women	Kendall's tau
Number of live children – ordered categorical	Lower pregnancy intention as number of live children increases	Kendall's tau
Primigravida - binary	Lower pregnancy intention in women who have already had at least one child	Kendall's tau
Birth interval – ordered categorical	Lower pregnancy intention below 24 months since last birth and over 5 years since last birth	Kruskal-Wallis
Gestation – ordered categorical	No strong evidence, possible increase in reported intention over time	Kendall's tau
Previous depression – ordered categorical	Lower pregnancy intention with increasing level of previous depression	Kendall's tau
Distance to health facility – continuous	Lower pregnancy intention with increasing distance to health facility	Kendall's tau
Religion – categorical	No particular relationship expected	Kruskal-Wallis
Tribe – categorical	No particular relationship expected	Kruskal-Wallis
Intimate partner violence - binary	Lower pregnancy intention with experience of abuse	Kendall's tau
Support – binary	Higher pregnancy intention with increasing support	Kendall's tau
Control – ordered categorical	Higher pregnancy intention with increasing control	Kendall's tau
Food insecurity – ordered categorical	Higher pregnancy intention with greater food security	Kendall's tau
Women's groups – binary	Prevalence expected to be too low to be of impact but potentially higher intention expected in women who attended women's groups	Kendall's tau
Infant feeding counsellors – binary		

Table 5-1 Variables considered at univariate analysis with hypothesised relationship with pregnancy intention and statistical test used

5.4.3 Multivariate analysis

5.4.3.1 Choice of regression method

There are several reasons why the choice of regression method for the multivariate analysis of the factors associated with pregnancy intention as measured by the LMUP is not immediately apparent. These include the non-Normal distribution of pregnancy intention and the ordinal nature of the LMUP score. The original developers of the LMUP recommend ordinal logistic regression using the full 13-point scale but studies published to date have used binary logistic regression (63, 239, 256). Linear regression and ordinal logistic regression with LMUP scores grouped into categories are also possibilities.

To determine the best approach for me to use, I compared five different approaches to the multivariate regression. These were: one linear model using the full range of LMUP scores, two logistic models with different cut points (one at the median and the other at the 'planned' pregnancy cut-off of nine) and two ordinal logistic models (LMUP in three groups (unplanned, ambivalent and planned as described in section 2.4) and the full 13-point range). Reducing the LMUP score from a range of 13 to two or three groups in some way negates the value of having collected it in the first place and potentially results in the loss of a large amount of information. The full details of the comparison of the different regression models are included in Appendix W but a summary is presented below.

I conducted univariate analyses for each variable using each regression method and found only small and non-significant differences in the findings from the different regressions. All five methods were taken forward to multivariate regression. I ran multivariate models containing all variables considered at univariate analysis for each regression method, with cluster as a random effect, and compared them. Again there were a few small differences between the models in the size but not the direction of effect. For the binary logistic regression the cut point at the theoretically valid division of pregnancies into intended and unintended was more justifiable than the data driven median cut point so the latter was dropped from further consideration.

I tested the assumptions for the linear and ordinal logistic regression models and they had been violated. However, with a large sample size such as this it is possible to relax these assumptions slightly (p115) (334). To further help accommodate the non-Normal distribution of the residuals and the heteroskedasticity of the variance,[xix] I used robust (or Huber–White) standard errors (p354) (334).

I developed a partial proportional odds ordinal logistic regression instead of the ordinal logistic regression to address the violations in the assumptions for that model. The partial proportional odds ordinal logistic regression could not be fitted using the full range of the LMUP scores so only the grouped LMUP scores were considered.

I compared the three models (linear with robust standard errors, binary logistic at the 'wanted pregnancy' cut-point and partial proportional odds ordinal logistic regression with the LMUP grouped into three categories) and the findings were consistent with any differences between the models very small. The partial proportional ordinal logistic regression model was the 'best' model given that its assumptions were not violated, but each model has different strengths and weaknesses.

The linear model has two significant advantages over the other models. Firstly, it uses the full range of LMUP scores from zero to 12 and, secondly, the results enable you to see how women vary across the LMUP scale. For example, using the linear multivariate regression model developed during these comparisons we can say that on average an unmarried woman has an LMUP score that is 3.72 (95%CI 3.06, 4.37) points lower than a married women, having controlled for the other variables in the model.

The main drawback of the binary logistic model, using nine as the cut-point above which the pregnancy is considered 'planned', is the resultant loss of information and efficiency having converted the ordinal thirteen-point scale to a binary outcome. It also only gives us an estimate of effect over one cut-point.

[xix] Linear regression models assume that the variance of the dependant variable (LMUP score in this case) is homoskedastic, meaning that that its variance is constant across the values of the independent variable. Heteroskedasticity is when the variance of the dependant variable is not constant across the range of the independent variable.

I could not calculate a stable ordinal logistic model using the full range of LMUP scores that did not violate the assumptions underpinning the model. This meant the grouped LMUP scores had to be used instead. Like the binary logistic regression this has resulted in a loss of information and efficiency, although it gives estimates of effect across two cut-points as opposed to one. However, the interpretation of these odds ratios is more complex, as described more fully in Appendix W.

The aim of my analysis was to develop an understanding of the factors influencing pregnancy intention in Mchinji District, both as a description in its own right and to inform the analysis of the relationships between pregnancy intention and maternal and neonatal health. In this regard both the linear and partial proportional odds regressions offer more insight than the binary logistic regression. The findings of the linear and partial proportional odds regressions are very similar in terms of what is significant (see Table 13-5 in Appendix W) but the interpretation of the linear regression is more informative. I therefore elected to use the linear regression with robust standard errors as the regression technique for the development a multilevel model.

5.4.3.2 Development of multivariate model

Using all variables assessed in the univariate analysis I ran forward and backward stepwise linear regressions and compared their findings. However, stepwise selections are not without their problems, not least that they remove theory and prior experience. Whilst they can be useful for developing a model that will be used to predict an outcome (p340-1) (334), I was seeking to develop an explanatory model. For this reason I took a hierarchical approach to the creation of the final multivariate model (335).

The aim of developing a multivariate model was to understand the effects of various potential determinants of unintended pregnancies. In this case, unlike the creation of a predictive model, the decision on which factors to include is not only based on statistical significance but also on a conceptual framework that describes the theoretical hierarchy among the determinants. This also enables a consideration of both the direct and indirect effects of

each factor. As Victora et al. explain, *'Ultimately, most ill health…may be ascribed to poverty [often assessed by] variables such as family income, parental education or the number and type of household appliances. Such factors, however, rarely cause ill health directly and henceforth are referred to as distal determinants. These factors are most likely to act through a number of inter-related proximate determinants [that] may be sub-divided into groups which are inter-related in a hierarchical or parallel way'* (p225) (335). Davis and Blake took such an approach to the fertility literature in 1956 by describing intermediate (or direct or proximal) determinants of fertility, which are biological and behavioural factors through which socio-economic, cultural and environmental variables (indirect or distal determinants) affect fertility (336). The proximal determinants have subsequently been further developed by Bongaarts (337). Approaching the analysis in this hierarchical way helps to ensure that the effect of distal factors is recognised and is not reduced or eliminated through incorrectly adjusting for proximate factors.

5.4.3.3 Conceptual hierarchy

Based on the literature on the determinants of pregnancy intention described in section 3.3.4 and taking temporal considerations into account, I developed the conceptual hierarchy, shown in Figure 5-2. The variables considered in each of the five hierarchical levels are shown in Table 5-2. Only variables that were associated with pregnancy intention at $p<0.10$ in the univariate analysis were considered for inclusion in the hierarchical model.

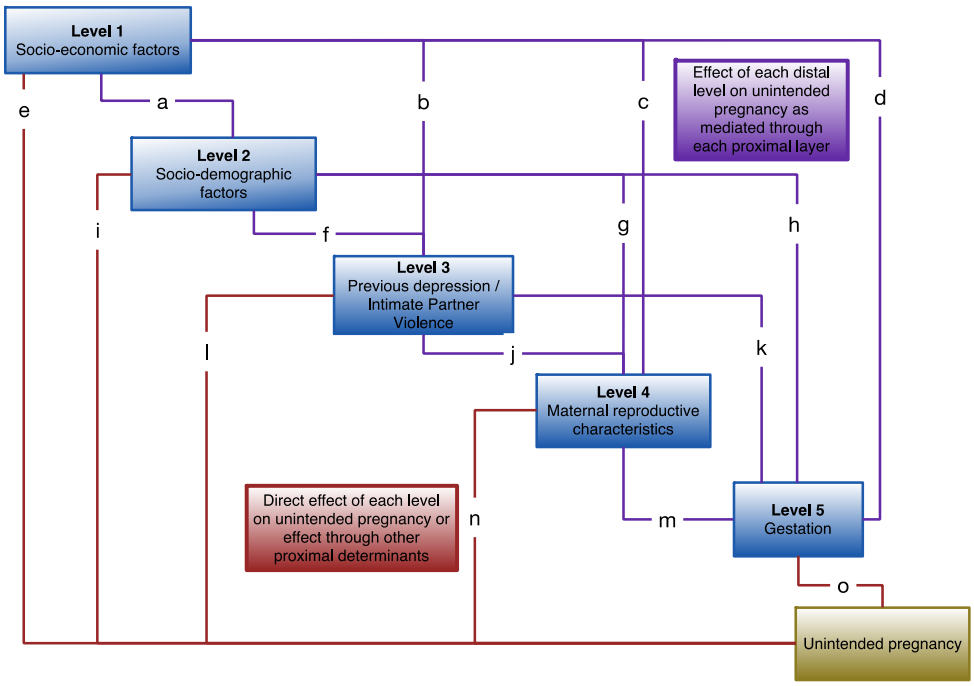


Figure 5-2 Conceptual hierarchy for the determinants of pregnancy intention

Level of hierarchy	Variables considered
Level 1 - Socio-economic	Asset index
Level 2 - Socio-demographic	Woman's education
	Partner's education
	Partner's age
	Marital status
	Tribe
	Cluster
Level 3 - Previous depression / IPV	Previous episodes of depression
	Intimate partner violence
Level 4 - Maternal reproductive factors	Woman's age
	Number of live children
	Primiparity / time since last birth
Level 5 - Gestation	Gestation (months)

Table 5-2 Variables considered at each level of the hierarchy of determinants of pregnancy intention

Socio-economic status, measured by the asset index that has taken multiple variables into account, was assessed alone at Level 1. This is because I considered SES to be a distal determinant that influences many of the variables below it in the hierarchy, as well as potentially having a direct effect on pregnancy intention. I included socio-demographic variables next, including cluster as a random effect. This was because clusters do vary in their overall SES and I was only interested in the effect of cluster that was not due to differences in SES. I placed previous depression and intimate partner violence (IPV) in Level 3, before maternal reproductive factors in Level 4, in recognition of the fact that we are looking at previous experience of depression or IPV whereas the maternal reproductive factors are measures of current status. Gestation was included in Level 5 as a marker of the time since conception and as the most proximate variable.

5.4.3.4 Hierarchical multivariate analysis methodology and interpretation

I used a linear regression with robust standard errors with antenatal LMUP score as the outcome measure of pregnancy intention. Each variable, or group of variables, in a level was introduced simultaneously into the model, starting with SES in Level 1, and the coefficients inspected. After each level

was introduced, any of the new variables with p-values of >0.10 were excluded by manual backwards-stepwise selection, starting with the variable with the largest p-value. After each variable was excluded the significance of the remaining variables in the same level was examined. Once the removal of the variables had finished, since all remaining variables in the level were p<0.10, the next level of variables was added to the regression model. Once a variable had been accepted into the model it was not subsequently removed, even if the inclusion of variables from lower levels in the hierarchy meant that it was no longer statistically significant.

Variables higher in the hierarchy influence those below them, either directly or indirectly. Socio-economic status was introduced at Level 1 of the hierarchy and may affect pregnancy intention either indirectly through the other levels in the model (pathways a, b, c and d in Figure 5-2) or through other proximate determinants or directly (pathway e). This analysis shows the overall effect of the SES alone and not (improperly) controlled for the proximal factors that are partly determined by SES.

Level 2 contains socio-demographic variables such as education level and marital status. These factors may affect pregnancy intention either through the other levels in the model (pathways f, g and h) or through other proximate determinants (pathway i). The coefficients for the socio-demographic variables tell us their effect having (properly) controlled for SES. The new coefficients for the Level 1 variable of SES in model 2 give the estimate of its effect that is not mediated through the Level 2 socio-demographic variables (pathway e). Level 2 variables with a p-value of >0.10 were excluded using manual backwards stepwise regression and the variables of Level 3 were then added to the regression model.

Level 3 is previous depression or experience of IPV which is influenced by the factors in Levels 1 and 2 above it and which can affect pregnancy intention either through Levels 4 and 5 (pathways j and k) or through other proximate determinants (pathway l). The coefficients for the previous depression and IPV variables (Level 3) tell us their effect on pregnancy intention adjusted for the confounding roles of the socio-economic and socio-

demographic variables in Levels 1 and 2. The new coefficient for the Level 1 variable, SES, gives an estimate of its effect that is not mediated through socio-demographic factors, previous experience of depression or IPV (pathway e) and the new coefficients for the socio-demographic factors are estimates of their effects that are not mediated through previous experience of depression or IPV (pathway i). Level 3 variables with p-values of >0.10 were excluded using manual backwards stepwise regression.

Next the maternal reproductive characteristics of Level 4 were simultaneously added to the model. Level 4 contains factors such as the number of live children a woman has and the time since the last birth that are affected by the distal determinants in Levels 1 to 3. Maternal reproductive characteristics may influence pregnancy intention through the final level of the model, Level 5, (pathway m) or through other proximate determinants (pathway n). The coefficients for the maternal reproductive characteristics tell us the effect of each factor on pregnancy intention adjusted for the confounding effects of the variables in Levels 1-3. The new coefficients for the variables in Levels 1-3 are estimates of their effect on pregnancy intention that are not mediated through the variables at the lower levels of the hierarchy (pathways e, i and l).

Finally, Level 4 variables with p-values of >0.10 were excluded, all variables previously accepted were maintained and the Level 5 variable of gestation was added to the regression model. Gestation is a marker of the time since conception, that is the time that we are primarily interested in, and was included to account for any possible differences in reported level of pregnancy intention that are due to the timing of the assessment. Gestation influences pregnancy intention through pathway o.

The complete model now tells us: the residual effect of socio-economic status on pregnancy intention that is not mediated through socio-demographic factors, previous depression, IPV, maternal reproductive characteristics or gestation (pathway e), the residual effect of socio-demographic variables on pregnancy intention that is not mediated through previous depression, IPV, maternal reproductive characteristics or gestation (pathway i), the residual effect of previous depression and IPV on pregnancy

intention that is not mediated through maternal reproductive characteristics or gestation (pathway l), the residual effect of the maternal reproductive characteristics that is not mediated through gestation (pathway n) and the unconfounded effect of gestation on pregnancy intention (pathway o).

5.4.4 Sensitivity analyses

I compared the final multivariate linear regression model with the partial proportional odds ordinal logistic regression model in terms of the selection of variables for the final model. This was because the dependent variable, LMUP, is constrained within a range of zero to 12 and the effect of factors cannot therefore be the same across each value and because of the potential for some error to be introduced into the linear regression model by the assumption of a Normal distribution of residuals.

As there are equally justifiable reasons for having maternal reproductive factors at Level 3 and previous depression/IPV at Level 4, the opposite of their current places, I repeated the multivariate hierarchical linear regression with these levels reversed to see if this had any effect. Finally, I repeated the multivariate hierarchical linear regression using the LMUP data without missing values imputed.

5.5 Methodology for the analysis of the relationships between pregnancy intention and maternal and neonatal outcomes

5.5.1 Descriptive analysis

The extent of loss to follow-up was examined and the women who were lost to follow-up were compared with those who were not. To investigate the risk of selection bias I used two-sided t-tests for age, socio-economic status, parity and birth interval, two-sided chi-squared tests for marital status and education and the Kruskal-Wallis one-way analysis of variance for antenatal LMUP score. First the outcomes of interest and then the antenatal, delivery and postnatal factors were described in terms of their prevalence. Antenatal and delivery factors are reported at the level of the mother; postnatal factors are a mixture of maternal (e.g. postnatal problems) and baby (e.g. immunisations).

5.5.2 Univariate analysis

The univariate associations between the antenatal LMUP score (treated as a continuous exposure) and the antenatal, delivery and postnatal factors (a mixture of binary, categorical, ordered categorical and continuous outcomes) were tested using the Kendall's tau or the Kruskal-Wallis tests and logistic, ordinal logistic or linear regression as appropriate. As per the analysis of the determinants of pregnancy intention, the Kendall's tau was used where the outcome variable was binary or the hypothesised relationship was that the LMUP score would gradually increase or decrease across the categories of an ordered categorical variable. Where the variable was not ordered categorical or the LMUP score was not expected to increase or decrease consistently across the categories, the Kruskal-Wallis test was used.

The univariate associations between behaviours (now considered as the exposure) and miscarriage, stillbirth, neonatal death and low birthweight (LBW) were assessed using logistic regression. I used linear regression for the relationships between behaviours and postnatal Self-Reporting Questionnaire (SRQ) score.

5.5.3 Multivariate analysis

I created a composite binary variable of adverse pregnancy outcome, where miscarriage, stillbirth, LBW and neonatal death were combined, as I expected the direction of effect of pregnancy intention to be the same for each component. Other studies have taken this approach, for example, creating a composite outcome variable for pregnancy loss (miscarriage, induced abortion and stillbirth) (130). I assessed each outcome individually to check for any relationships that had been obscured by the composite variable.

5.5.3.1 Conceptual hierarchy

I developed the conceptual hierarchy shown in Figure 5-3 for the analysis of the relationships between antenatal LMUP score and maternal and neonatal outcomes. In Figure 5-3 'pregnancy outcome' could be substituted for either the composite adverse pregnancy outcome of miscarriage, stillbirth, low

birthweight and neonatal death, or the maternal outcome of postnatal depression.

The model starts by assessing the univariate relationship between pregnancy intention, at Level 1, and pregnancy outcome. The hierarchy then incorporates the findings of the analysis of the determinants of pregnancy intention (presented in Chapter 8) at Level 2. Antenatal, delivery and postnatal factors were added sequentially at Levels 3, 4 and 5.

The variables considered at each of these levels were based on the literature describing the factors associated with the primary outcomes, presented in sections 3.3.1.4, 3.3.2.7 and 3.3.3.6 and the evidence for how pregnancy intention is related to antenatal, delivery and postnatal care uptake, described in section 3.3.5. The variables considered at each level are listed in Table 5-3 but were only included if their univariate relationship with the primary outcome was significant at $p<0.1$.

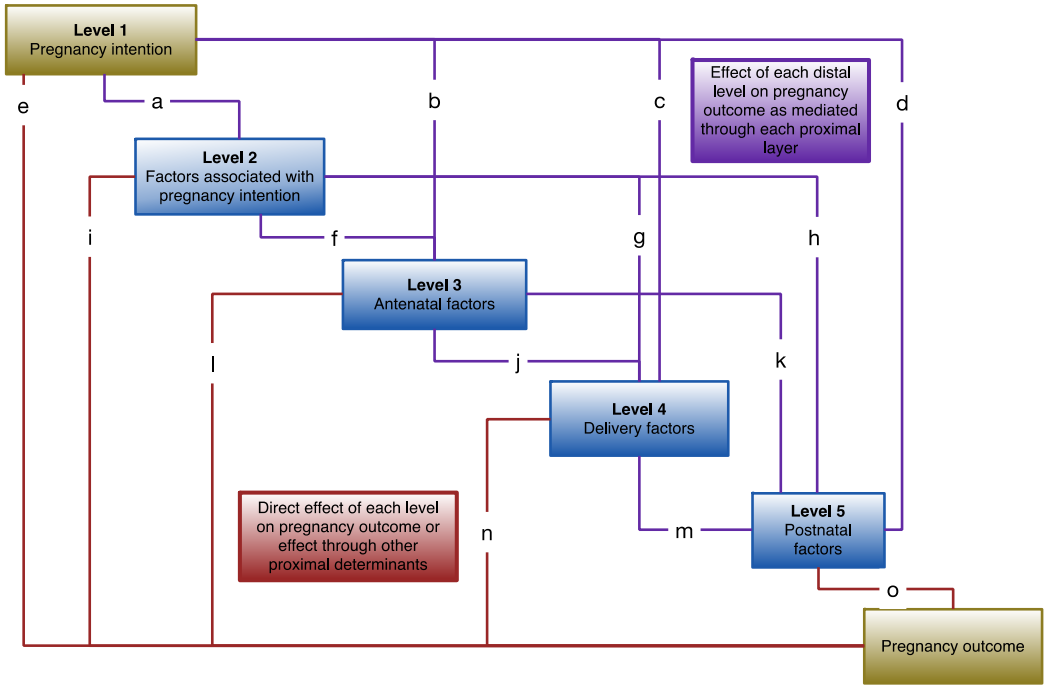


Figure 5-3 Conceptual hierarchy for the relationships between pregnancy intention and pregnancy outcome

Level of hierarchy	Variables considered	
Level 1 – Pregnancy intention	Antenatal LMUP score	
Level 2 – Factors associated with pregnancy intention	Socio-economic status	Previous episodes of depression
	Woman's education	Partner's age
	Number of live children	Woman's age
	Marital status	Cluster
	Intimate partner violence	Primiparity / time since last birth
Level 3 – Antenatal factors	Attendance at antenatal care	Total attendances at antenatal care
	Months at booking	Tetanus vaccination
	Took intermittent preventative treatment for malaria during pregnancy	Slept under an insecticide treated bed net
	Iron/folic acid supplementation	Voluntary counselling and testing for HIV
	Antenatal problems	Antenatal depression
Level 4 – Delivery factors	Delivery location	Skilled birth attendant
	Duration of labour	Clean delivery
	Use of mwana mphepo	Transfer during labour
	Delivery problems	Multiple birth
	Gender	
Level 5 – Postnatal factors	Initiation of breastfeeding	Duration of breastfeeding
	Exclusive breastfeeding	Attended postnatal check
	Maternal postnatal problems	Infant postnatal problems
	Baby slept under a bed net	Vaccinations

Table 5-3 Variables considered at each level of the hierarchy of the relationship between pregnancy intention and maternal and neonatal outcome

Miscarriage, stillbirth, low birthweight and neonatal death were considered for inclusion in the hierarchical analysis of postnatal depression depending on

their significance. Miscarriage was considered at the Level 3 (antenatal factors), stillbirth and low birthweight at Level 4 (delivery factors) and neonatal death in Level 5 (postnatal factors). Simultaneously modelling the effects of miscarriage and delivery variables, or stillbirth and postnatal variables, is challenging and was handled as described in section 5.1.4.

5.5.3.2 Hierarchical multivariate analysis methodology and interpretation

I used logistic regression to assess the relationship between the composite adverse pregnancy outcome of miscarriage, stillbirth, low birthweight or neonatal death in a baby level analysis. The geographical cluster variable was included as a random effect at Level 2. For the Self-Reporting Questionnaire score as the measure of postnatal depression I used linear regression, again with cluster as a random effect, in a pregnancy level analysis. I checked that the residuals were Normally distributed to confirm the appropriateness of the linear regression.

I followed the same methodology for the hierarchical multivariate analysis of the relationships between antenatal pregnancy intention and maternal and neonatal outcomes as I had used for the analysis of the factors associated with antenatal pregnancy intention, fully described in section 5.4.3.4. In brief, I used the conceptual hierarchy (Figure 5-3) to determine the factors at each level and created a multivariate hierarchical model to determine the way in which antenatal LMUP score is related to maternal or neonatal outcomes. All variables in a level were added simultaneously and the coefficients inspected. Any of the new variables with p-values of >0.10 were excluded by manual backwards stepwise selection, starting with the variable with the largest p-value. Once accepted, variables were not removed from the model.

The interpretation of the model is also the same, with variables at the top of the hierarchy influencing those below them through the pathways drawn in Figure 5-3. By examining the way in which coefficients change as levels are added to the model we can explore how pregnancy intention influences pregnancy outcome, either directly or indirectly through its effect on antenatal, delivery and/or postnatal factors.

5.6 Chapter summary

In this Chapter I have explained how I managed the data, including validation and cleaning, as well as the procedures for handling and imputing missing data and calculating my measure of socio-economic status. I have detailed the methodology for the univariate and multivariate analyses of both the determinants of unintended pregnancy and the relationships between the degree of pregnancy intention and maternal and neonatal outcomes. This is the end of Section I, the 'Introduction and Methods'.

Section II, the results Section, starts in the next Chapter with the validation of the London Measure of Unplanned Pregnancy in the Chichewa language.

Section II Results

Section II contains the results for the first three aims of the thesis. The first Chapter, Chapter 6, presents the validation of the Chichewa version of the London Measure of Unplanned Pregnancy. Chapter 7 and Chapter 8 describe the pregnant women recruited into the cohort and the univariate and multivariate analyses of the determinants of pregnancy intention respectively. Chapter 9 describes the postnatal follow-up of the cohort and presents the descriptive and univariate analyses of the antenatal, delivery and postnatal behaviours and pregnancy outcomes of interest. Multivariate hierarchical models are developed in Chapter 10 to explore the relationships between antenatal pregnancy intention and pregnancy outcomes. The final Chapter in this Section, Chapter 10, describes the methodology and results of focus group discussions conducted around the issue of postpartum family planning.

Chapter 6 Validation of the Chichewa LMUP

Before I could use the London Measure of Unplanned Pregnancy in my data collection I needed to validate it in the local language to ensure that it was an appropriate measure of pregnancy intention in this setting. I carried out this work in late 2012 and published the validation of the Chichewa version of the LMUP in BMC Pregnancy and Childbirth in November 2013. I am first author on this paper having completed the fieldwork, analysis and written the first and subsequent drafts of the paper. It is freely available online here and is presented in its entirety in Appendix X.

This Chapter presents the methodology, results and conclusions from that paper; the introduction has been omitted as this would be repetitious of material in previous Chapters. The tables and references are numbered for continuity with the rest of the thesis. The next Chapter will present the descriptive analysis of the women recruited into the cohort.

6.1 Methods

The London Measure of Unplanned Pregnancy (LMUP) was originally designed for self-completion. Given the low levels of literacy in Mchinji District (22) this was not felt to be a viable option. The LMUP was therefore adapted for interviewer-administration along the same lines as the Indian validation (71).

The interviewer-administered English LMUP was sent to three native Chichewa speakers (two female, one male, all involved in health research) who each independently translated it into Chichewa. All translators were given a short briefing on the purpose and background of the LMUP prior to conducting the translation. I reviewed the three translations and discussed the differences at a consensus meeting of the three translators plus a locally trained nurse-midwife and health researcher. The agreed translation produced by this meeting was sent for back-translation to a native English speaker who spoke Chichewa fluently as a second language. This person was only broadly aware of the purpose of the LMUP to avoid subconsciously influencing her translation.

Following back-translation the Chichewa LMUP was pre-tested using cognitive interviewing techniques. The aim of these interviews was to gauge the ease with which women understood the questions, to check the translation and to assess the acceptability of the questions. Pregnant women were recruited for these interviews from Mchinji District Hospital (MDH) antenatal clinic.

The final version of the Chichewa LMUP was field-tested at three antenatal clinics in Mchinji District: MDH, Kochilira Community Hospital and Ludzi Community Hospital. Three women living in these areas who had previously worked with our organisation were trained to conduct the interviews. All pregnant women aged 15 or over attending any one of these clinics in the week of 8th October 2012 were invited to participate. Given the accepted guidance for an appropriate sample size for the validation of a questionnaire, 100 was selected as the target total sample size with at least 50 completing the re-test (338).

The interviewer verbally explained the purpose of the research to the potential participant with the aid of a written information sheet that the participant retained. All women completed the six LMUP questions and a short set of demographic and obstetric history questions and were invited to return to the same antenatal clinic on any day the following week to complete the re-test. They were offered 500 Malawian Kwacha (£1/US$1.52/€1.15) to cover their transport costs if they returned so that they would not be out of pocket. The women were given a unique identification number on a card that they were advised to bring with them when they returned. This number was used to link the test and re-test data as no personal identifiable data were collected.

Respondent's answers were inputted directly onto password protected Personal Digital Assistants (PDAs) during the interview to maximise the safety of the data. Pendragon software was used to design the questionnaires and to control what data can be entered, reducing the risk of errors during data entry. Data were transferred directly to an Excel spreadsheet on a laptop via USB, eliminating transcription errors. All data were anonymous but were stored in encrypted files.

6.1.1 Analysis of psychometric properties

The analysis was conducted in Stata version 12 using a classical test theory-based approach to facilitate comparison with the original UK study and previous validations (71, 126).

In addition to the feedback from the cognitive interviews, acceptability was assessed by examining missing data rates with lower levels of missing data indicating greater acceptability (339). To assess item discrimination the item-endorsement values were checked to ensure that no item had an endorsement of greater than 80% (340). The distribution of total scores was considered to evaluate the targeting of the scale and ensure that the full range of scores was captured.

To assess reliability, internal consistency was evaluated by calculating the Cronbach's α statistic using the standard cut-off of 0.7 (341). In addition all

item-rest correlations were examined with a minimum correlation of 0.20 considered acceptable (340). Test-retest stability was assessed using the weighted κ with a score above 0.60 considered to be substantial (342). The simple Pearson's correlation between scores at the two administrations was also assessed; 0.60 was the cut-point for acceptable correlation as was used in the validation in India (71).

As there is no agreed 'gold standard' for the measurement of pregnancy intention it is not possible to assess the concurrent criterion validity of the LMUP by comparing it to this.

Construct validity was examined using two methods: hypothesis testing and principal component analysis. Hypotheses were generated based on the literature on pregnancy intention and hypotheses used in previous LMUP validations adapted to suit the Malawian context (8, 71, 126). Given the non-parametric distribution of pregnancy intention scores the Wilcoxon Rank-Sum (Mann Whitney U) test was used to test the three main hypotheses that: pregnancies will be reported as more unplanned (i.e. LMUP score will be lower) in women with a four or more live children; women who are unmarried; and women aged under 20 or over 30. Principal component analysis (PCA) was used to evaluate the internal structure of the LMUP. The scale would be considered valid if all items loaded onto one component with an Eigenvalue larger than one (i.e. are measuring the same construct) (343). Our findings led to us conducting a sensitivity analysis to determine the effect of removing the first question (contraception use) on the validity of the scale.

6.2 Ethical Approval

The University College London Research Ethics Committee and the College of Medicine Research Ethics Committee at the University of Malawi granted ethical approval for this study. Approval to conduct the research in Mchinji District's antenatal clinics was given by the District Medical Officer. Written informed consent to participate was taken, with thumbprints used if women were illiterate.

6.3 Results

6.3.1 Pre-testing

Cognitive interviews were conducted on five pregnant women attending the Mchinji District Hospital antenatal clinic. The women were aged 17-38 (median 20) and four of the five women were married. They had between three and nine years of education, had had between zero and six previous pregnancies and were between six and nine months pregnant.

In general the women reported that the instructions were easy to follow and the questions easy to understand. The main change that was made during the cognitive interviews was on the first question; contraceptive use in the month they became pregnant. General knowledge of contraception seemed variable and this impacted on the answers given to the first question. For example, two women reported not using contraception but on further probing they were (one had had a tubal ligation, one was using a natural method of family planning). Probing around this issue revealed that the women only seemed to think of methods such as pills, injections or condoms and did not think beyond these. Four of the five understood that family planning was a way of 'stopping pregnancy' but it seemed that the women were interpreting the Chichewa word 'zolerera' too narrowly. There was not a better word available and so it was decided that we would preface the question with some additional information to help the respondents. The text that was added was:

'This question asks about contraception. This might include condoms, pills, injections, implants, coils, vasectomy, female sterilisation or any other method aimed at delaying pregnancy.'

The second change that was made was to alter the options available for question six, pre-pregnancy preparations, to include the more contextually relevant option 'saved money for healthcare.' This is not applicable in the UK but is relevant in the Malawian context and indeed was included in the Indian validation. Discussion with local women and midwives indicated that the smoking and alcohol responses were unlikely to be relevant in this context

however the decision was made to include them in the field test and base their inclusion or exclusion on the data collected.

6.3.2 Field test: Women's characteristics

Data were collected from 125 women, surpassing the target of 100. Women were aged from 15-43 (median 23, mean 24.5) and had between zero and seven live children (median 1). Eighty percent of the women were married and the majority (69.6%) had primary education only (see Table 6-1).

Socio-demographic characteristics	LMUP field test n=125	LMUP retest n=70	LMUP non-retest n=55	Comparison of retest v non-retest groups	Mchinji DHS 2010 data[xx]	Malawi DHS 2010 data
Age						
Mean (sd)	24.4 (5.9)	25.0 (6.1)	24.4 (6.3)	P=0.312		
Median	23	25	22			
Range	15 – 43	15 - 41	16 - 43			
Age group	**n (%)**	**n (%)**	**n (%)**			
15-19	28 (22.4)	14 (20)	14 (25.5)			
20-24	41 (32.8)	20 (28.6)	21 (38.2)			
25-29	28 (22.4)	19 (27.1)	9 (16.4)			
30-34	19 (15.2)	13 (18.6)	6 (10.9)			
35-39	7 (5.6)	3 (4.3)	4 (7.3)			
≥ 40	2 (1.6)	1 (1.4)	1 (1.8)			
Children						
0	39 (31.2)	21 (30)	18 (32.7)	P=0.255		
1	35 (28.0)	16 (22.9)	19 (24.6)			
2	23 (18.4)	15 (21.4)	8 (14.5)			
3	10 (8.0)	5 (7.1)	5 (9.9)			
≥ 4	18 (14.4)	13 (18.6)	14 (25.5)			
Marital status						
Married	101 (80.8)	54 (77.1)	47 (85.5)	P=0.242	68%	81.3%
Unmarried	24 (19.2)	16 (22.9)	8 (14.5)		32%	19.7%[xxi]
Education						
None	6 (4.8)	3 (4.3)	3 (5.5)	P=0.978	18.2%	15.2%
Primary	87 (69.6)	48 (68.6)	39 (70.1)		64%	64.8%
Secondary	29 (23.2)	17 (24.3)	12 (21.8)		17.8%	18.1%
Tertiary	3 (2.4)	2 (2.9)	1 (1.8)		0%	1.8%
Partner's occupation	Missing data for 5		Missing data for 5			
Unemployed/ student	10 (8.3)	5 (7.1)	5 (10)	P=0.076	7.9%	18%
Agriculture/ Casual labour	53 (44.2)	37 (52.9)	16 (32)		72.4%	82%
Employed/ Business man	57 (47.5)	28 (40)	29 (58)		19.7%	

Table 6-1 Characteristics of women completing the LMUP field test and re-test and compared to Mchinji District and Malawi

[xx] DHS data refers to all women all aged 15-49 and not only to pregnant women.
[xxi] Never married rather than currently unmarried.

6.3.3 Field test: Psychometric properties

There were no missing data and no question had a response with more than 80% endorsement. The full range of LMUP scores from zero to 12 was captured in the field test (see Figure 6-1). The median score was six.

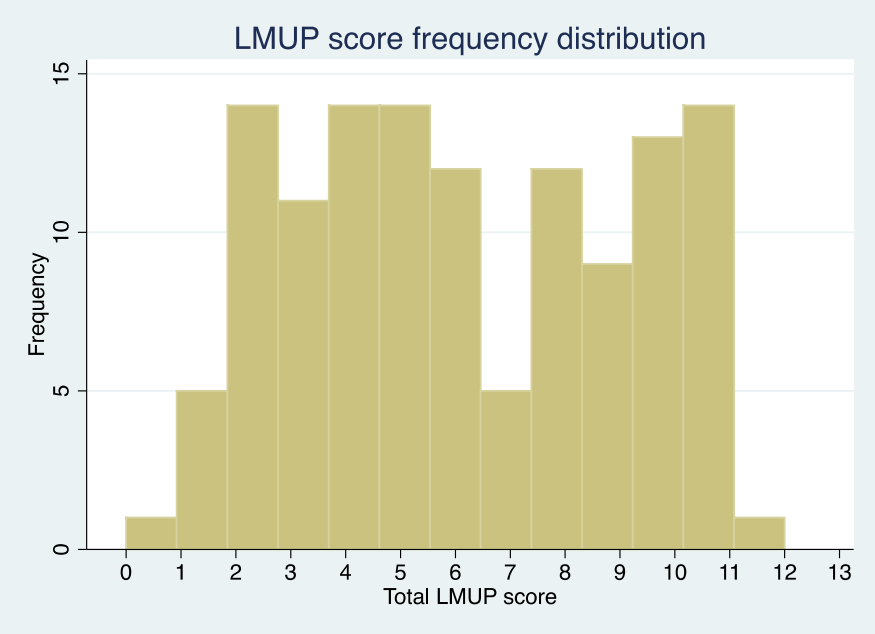


Figure 6-1 Distribution of Chichewa London Measure of Unplanned Pregnancy scores

The Cronbach's α for the whole scale was 0.78. Item-rest correlations were above or around 0.7 for questions two to five, was borderline for question six (0.16) and was low for question one (0.05) (see Table 6-2).

74 women returned for the re-test but due to interviewer error data were only available on 70. The women who returned for the re-test were not significantly different from those who did not return in terms of age, parity, number of live children, marital status, education or partner's occupation (see Table 6-1). The average test-retest interval was 7 days (range 5-10 days). The median difference in the scores at test and re-test was zero (mean -0.2). The weighted κ statistic was 0.799 and the Pearson correlation coefficient was 0.801 showing good stability.

Hypothesis testing confirmed that women who already had four or more children alive (p=0.005), unmarried women (p=0.003) and women who were

below 20 or over 29 (p=0.012) were all more likely to report their pregnancies as more unintended (see Figure 6-2, Figure 6-3 and Figure 6-4).

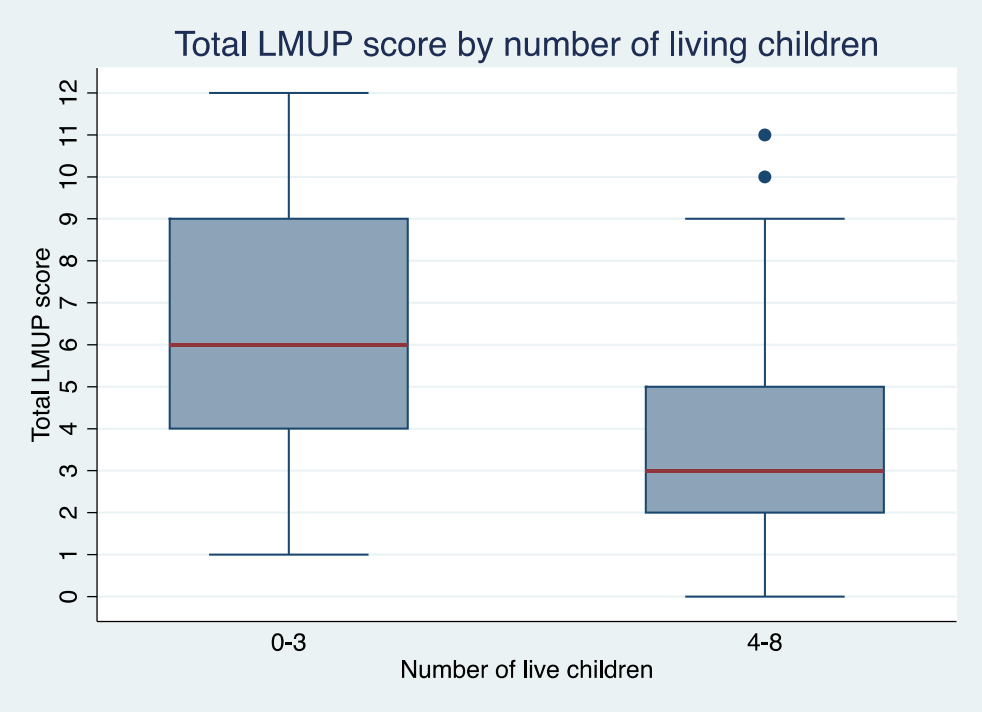


Figure 6-2 Box and whisker plot showing median and inter-quartile range of London Measure of Unplanned Pregnancy score by number of living children

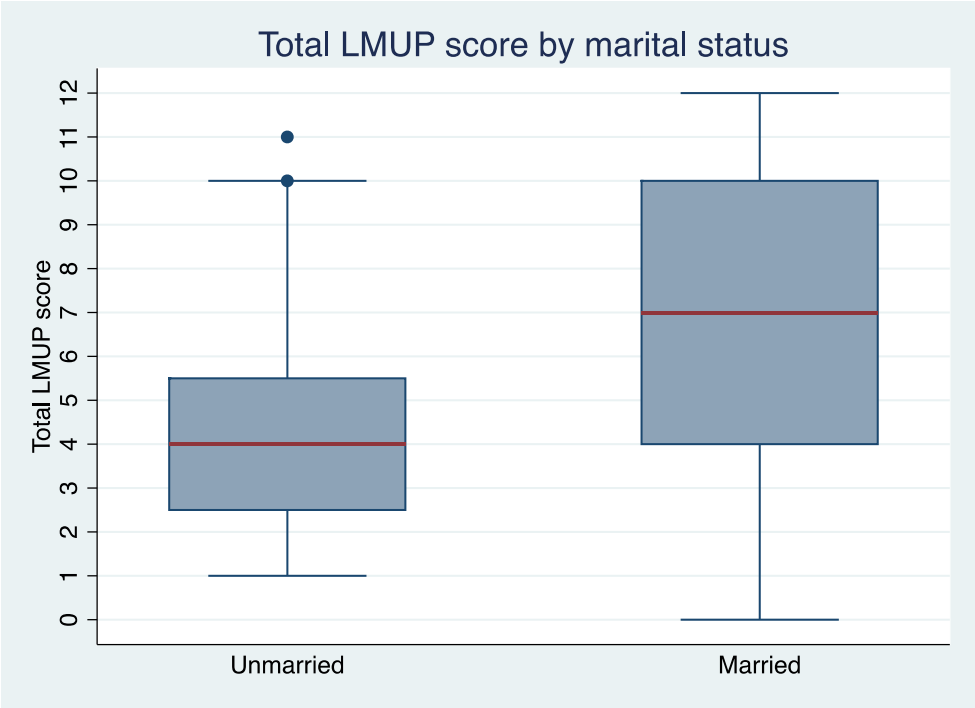


Figure 6-3 Box and whisker plot showing median and inter-quartile range of London Measure of Unplanned Pregnancy score by marital status

Figure 6-4 Box and whisker plot showing median and inter-quartile range of London Measure of Unplanned Pregnancy score by age group

Principal component analysis confirmed that five items clearly measured one construct loading onto one component with an Eigenvalue of 3.1. A second component was of borderline significance with an Eigenvalue of 1.00 and mainly represented the question on contraception (loading of 0.99), in keeping with the lower item-rest correlation (see Table 6-2).

Items	Item-rest correlations	Component 1 (Eigenvalue=3.1) Item loadings	Component 2 (Eigenvalue=1.0) Item loadings
1 - Contraception	0.05	-0.04	**0.99**
2 - Timing	0.69	**0.48**	0.07
3 - Intention	0.79	**0.51**	-0.02
4 - Desire	0.74	**0.50**	0.06
5 - Partner	0.72	**0.48**	-0.03
6 - Preparation	0.16	**0.14**	0.07

Table 6-2 Principal Component Analysis of Chichewa London Measure of Unplanned Pregnancy

6.3.4 Field test: Sensitivity analysis

The LMUP was re-analysed without the question on contraception use. This reduced the LMUP scores to zero to 10 and gave a median score of four for our data. Cronbach's α increased from 0.78 to 0.83 and all items loaded on to one component with an eigenvalue of 3.10. All hypothesis tests remained statistically significant (data not shown).

6.3.5 Finalisation of the Chichewa LMUP

The responses to the question on pre-pregnancy preparation were inspected to determine which options should remain in the final version of the Chichewa LMUP. No respondents reporting cutting down on smoking (99.8% of women in Mchinji do not use any form of tobacco (22)) and only one woman reported cutting down on alcohol. These items were therefore removed from the final version of the Chichewa LMUP.

6.4 Discussion

The validation of the Chichewa LMUP using classical test theory shows that the Chichewa LMUP meets the pre-set criteria for acceptability, endorsement, targeting, internal consistency, reliability and construct validity by hypothesis testing. The original English LMUP has now been translated and validated into five other languages in high-, middle- and low-income countries. Although analysis by classical test theory shows slightly weaker performance by all translations than the original, they remain acceptable (see Table 6-3).

	Internal consistency Cronbach's α	Eigenvalues of PCA components	Test-retest weighted κ
UK	0.92	4.3	0.97 and 0.86
USA – English	0.78	2.9	0.72
USA - Spanish	0.84	3.4	0.77
India - Kannada	0.76	2.66 and 1.05	0.43
India - Tamil	0.71		
Malawi	0.78	3.1 and 1.00	0.80

Table 6-3 Comparison of results of classical test theory analysis for validation of the original London Measure of Unplanned Pregnancy and its translations

The only slight deviation from the pre-set criteria for the Chichewa LMUP was on the principal component analysis. Here all items were expected to load onto one component with an Eigenvalue larger than one thus demonstrating that all components are measuring the same construct. In actual fact they loaded onto two components with an Eigenvalue larger than one, although the second component had an eigenvalue of 1.00 making it very borderline. The same thing was found in the Indian validation and it was noted that the *'second component … mainly represented item one [contraception] (loading of 0.78)'* (p312) (71). In the Chichewa LMUP this was also true with the second component almost entirely representing the question on contraception (loading of 0.99). The Mokken analysis conducted in the USA validation indicated that the contraception question *'was not contributing greatly to the scale [but] the scale was still strong with the inclusion of this item'* (126).

In the original LMUP not using contraception was more strongly associated with intention to become pregnant than it appears to be in any of the subsequent translations. In the Malawian setting this might be explained by the fact that there is a high unmet need for family planning i.e. in Mchinji District 29.3% of married women who do not want another pregnancy in the next two years are not using any form of family planning (22). In this context the relationship between not using contraception and wanting to get pregnant is diluted. Similar factors may also be at play in the Indian setting and in the USA study that was conducted in low-income women. We recommend retaining the question on contraception in the Malawian setting for several reasons. Firstly, the scale is not compromised by its retention, secondly if the LMUP is used over time we may see this item becoming more relevant as unmet need for family planning falls and, finally, to enable easier comparison with LMUP use elsewhere.

6.5 Limitations

There are three main limitations to this study. Firstly, in Malawi abortion is illegal so we were not able to test the LMUP in women who we knew were and were not planning to continue the pregnancy to term. Despite this the

Chichewa LMUP could be used in women following induced or spontaneous abortion as it was developed and validated with abortion as an outcome of pregnancy in the original UK development (8). Secondly, we were only able to conduct a test-retest analysis during pregnancy. Subsequent work is underway that will allow a postpartum re-test analysis to be conducted. Finally, we recruited women from antenatal clinics meaning that we missed women who do not attend for antenatal care. Although in Mchinji District over 90% of women receive antenatal care from a skilled attendant at least once during their pregnancy (22)), the 10% of women who do not attend are likely to be significantly different from those who do in many ways. This might account for why the women in this study tended to have higher levels of education and of partner employment than was expected from the district level data in the DHS, as seen in Table 6-1.

6.6 Conclusion

The Chichewa LMUP is a valid and reliable measure of pregnancy intention in women who speak Chichewa and is now an available tool for research and surveillance in Malawi. It is the first time the LMUP has been formally validated in a low-income country and in so doing it helps to demonstrate that the concept of pregnancy planning is applicable in these settings. The Chichewa LMUP represents a methodological advance on the DHS-style pregnancy intention questions, particularly by allowing a more nuanced picture of pregnancy intention and planning. It can be used for a range of research questions pertaining to pregnancy intention such as enhancing understanding of pregnancy planning behaviour or investigating relationships between pregnancy intention and maternal and neonatal health. This should lead to insights for the provision of family planning programmes to aid Malawi in designing programmes to meet the unmet need for family planning and reduce maternal and child deaths.

6.7 Chapter summary

This Chapter has presented the methodology and results of the validation of the London Measure of Unplanned Pregnancy in the Chichewa language. It was found to be a valid measure and I was therefore able to use it in my

research to assess the degree of pregnancy intention of pregnant women in Mchinji District. The next Chapter describes the women recruited into the cohort in terms of their socio-economic and socio-demographic characteristics and their obstetric history. I will also examine the distribution of LMUP and SRQ scores and previous experience of depression. This will lead on to the multivariate analysis of the determinants of unintended pregnancy in women in Mchinji District in Chapter 8.

Chapter 7 Descriptive analyses of the cohort

In this Chapter I explore the characteristics of the women included in the cohort. I map their distribution across Mchinji District and describe their socio-economic and socio-demographic characteristics and their obstetric and psychiatric histories. Women's responses to each of the LMUP questions and the distribution of the total LMUP score are examined. In the next Chapter I will take this analysis forward to explore the factors that are associated with pregnancy intention.

7.1 Recruitment profile

The target recruitment number was 4,000 based on the sample size calculation of 3,737 outcomes needed, as described in section 4.1. 4,553 pregnant women were identified using the surveillance system and an additional 1,334 were identified in the field. Of the 5,887 women identified, 4,244 completed the antenatal interview. Figure 7-1 shows that the most common reason why women were not interviewed was that they had already delivered by the time the data collector visited (as explained in section 4.4) and were therefore no longer eligible.

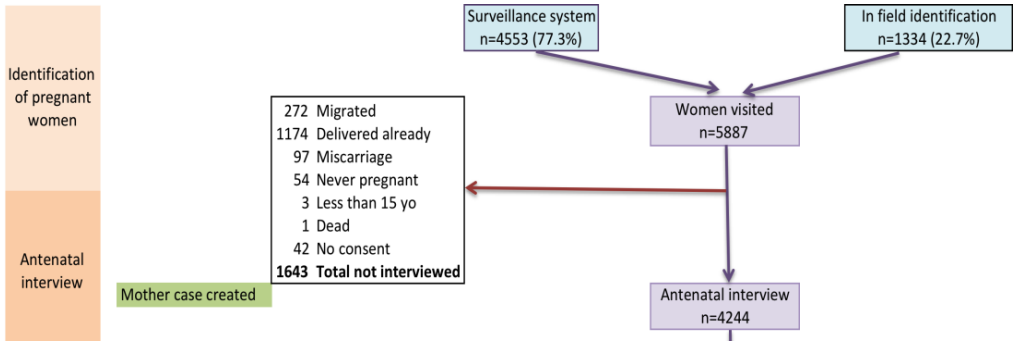


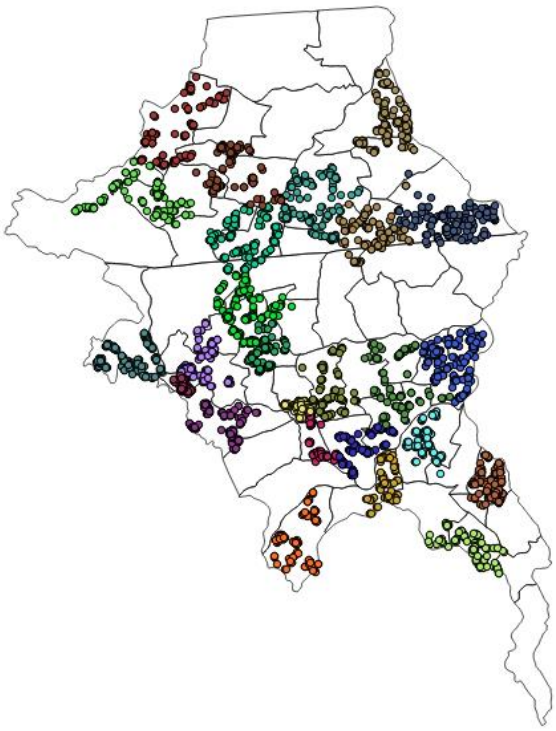
Figure 7-1 Recruitment of pregnant women into the cohort

Only 42 eligible women declined to participate, less than 1%. Of these, six (14.2%) were not able to give informed consent or participate because, for example, they were deaf or mute. 14 of the remaining 36 did consent to answer socio-demographic questions meaning that we are only missing data on 22 eligible women. Such low refusal rates negate the need for formal testing and suggest that these data are representative of the population of

pregnant women in Mchinji District. Whilst concerns could be raised about such a high level of consent, I believe that this was due to the nature of the relationship MaiMwana Project has with the community and the way in which the research was conducted. The data collectors were local women and they conducted recruitment face-to-face; both of these increase acceptability and response rates. Furthermore, MaiMwana has worked within the community for over a decade and is well regarded for its work on improving maternal and child health. This research was linked to the existing surveillance system, which the communities were already familiar with, and was introduced following a series of community sensitisation meetings and discussions with village chiefs and local traditional leaders who gave their permission for the research to be conducted in their areas. All these factors contributed to the high consent rate.

7.2 Map of women in each cluster

As described in section 4.2, women were recruited from 25 of the 49 previously defined geographical areas within Mchinji District. Using the GPS data, I mapped the location of the antenatal interviews; each colour represents a different one of the 25 clusters.



Map 7-1 Location of antenatal interviews

The slight inconsistencies seen between the cluster outlines and the location of interviews shown in Map 7-1 are due to several factors. Firstly, the catchment areas for the hospitals, which are used by the surveillance system to identify the women and create the unique identification numbers, do not align perfectly to these clusters. Secondly, some women were interviewed at their place of work rather than at their home; the former may not have been in the cluster whereas the latter was. Thirdly, some villages have grown since the clusters were originally defined and now span the boundaries. Finally, there are pre-existing inbuilt inaccuracies in all maps and GPS data collection which contribute to the observed inconsistencies.

7.3 Socio-economic status

I conducted a principal components (PCA) analysis to develop an asset-based measure of socio-economic status (SES), as described in section 5.3. The PCA generates a score for the SES of each woman based on the first component of the PCA. Although this could have been used as a continuous score I used it to group women into quintiles of the poorest 20%, second-poorest 20%, middle 20%, next-richest 20% and richest 20% as is common practice.

SES was associated with cluster, with women in the trading centres such as the Boma having higher SES scores than women in the more rural areas.

7.4 Socio-demographic factors

Table 7-1 shows the socio-demographic characteristics of the 4,244 women interviewed, along with their partner's age and education level as reported by the woman. There were no missing data for the mothers but data on the fathers, which was reported by the women, had a varying amount of missing data, as indicated in the table.

	Mother		Father	
	Freq.	Percent.	Freq.	Percent.
Age			n=4,071	
15-19	1,018	24.0	143	3.51
20-24	1,226	28.9	1,128	27.7
25-29	951	22.4	1,000	24.6
30-34	618	14.6	779	19.1
35-39	311	7.3	550	13.5
40-49	120	2.8	426	10.5
≥ 50	0	0	45	1.11
Range (median)	15-49 (24)		15-71 (28)	
Education			n=4,174	
None	422	9.94	334	8.00
Primary	3,215	75.8	2,678	64.1
Secondary	597	14.1	1,144	27.4
Tertiary	10	0.24	18	0.43
Current marital status				
Married	3,905	92.0		
Unmarried	339	7.99		
Religion				
Catholic	1,985	46.8		
Other Christian	2,091	49.3		
Muslim	94	2.21		
Other	74	1.74		
Tribe				
Chewa	3,597	84.8		
Ngoni	281	6.62		
Senga	207	4.88		
Yao	92	2.17		
Other	67	1.58		

Table 7-1 Socio-demographic characteristics of the women interviewed antenatally

Most women and their partners had no more than primary education (85.7% and 72.2% respectively) and extremely small numbers of women and men had any education beyond secondary school (10 and 18 respectively). Those with tertiary education tended to be from the Boma area – the main trading centre and therefore most urbanised part of the district.

While many women and their partners may have attended primary school for some time, not all will have completed primary school; the categorisations presented in Table 7-1 are too crude to pick this up. Women were additionally asked how many years of each level of schooling they and their partner had completed so it was possible to calculate the total number of complete years of schooling. These data were used for the main analysis.

The number of years of education a woman has completed is clearly related to her age but this can work in two ways. On the one hand, a 15 year old has had less time to complete as many years of education as a 25 year old but, on the other hand, women who are currently over 35 grew up in a time when girl's education was not prioritised and therefore they may have received less education. Analysis of level of education by age showed that in pregnant women in Mchinji District increasing age was associated with decreasing years of education ($p<0.001$), suggesting that there have been improvements in girl's education in the last few decades.

The majority (92%) of women reported being married. Women were also asked about their living arrangements but this was highly correlated with marital status with 99% of those unmarried living apart and 93% of married women living together all or most of the time (data not shown). This is largely due to the fact that in Malawian culture a man and woman living together are considered 'married' regardless of whether any religious or legal marriage ceremony has taken place.[xxii]

Age is also associated with marital status; unmarried women averaged 21.8 years of age whereas married women were 25.3 years old on average ($p<0.001$). Unmarried women had slightly more education than married women (5.85 years versus 5.32 years, $p=0.003$). Since increasing age is associated with lower levels of education and with marital status, I stratified the analysis of education and marital status by age group. Once age was taken into account there was no relationship between marital status and education except in the 15-19 and 30-34 age groups. Married women aged

[xxii] A traditional 'engagement' may have taken place, though this would not have been picked up by the questionnaire.

15-19 had fewer years of education than unmarried women of the same age (5.98 years versus 6.68 years, p=0.005). As these data are cross-sectional we do not know when marriage occurred in relation to the end of schooling. There may be reverse causality in that once a girl is married she is no longer able to attend school rather than she had already left school and then got married. Conversely married women aged 30-34 had more years of education than unmarried women of the same age (4.42 years versus 3.23 years, p=0.032).

The predominance of Christian religions and of the Chewa tribe is typical of the area. Indeed the characteristics of the women recruited are what would be expected based on the most recent Demographic Health Survey (22). The distribution of tribe does vary by cluster; for example there are more Senga tribe in Menyani, the cluster on the border with Zambia that is part of the Senga tribe's historical territory. The trading centres, the Boma and Kamwendo, have a greater mixture of tribes, whereas the Chewa tribe predominantly populates the more remote areas. Similar, but less marked, patterns are seen for religion.

7.4.1 Intimate Partner Violence

Women were asked the five questions comprising the Abuse Assessment Screen (see Table 4-4). This asked about physical, emotional and sexual abuse either ever, in the last year or whilst pregnant. Their responses are shown in Table 7-2. Over a fifth of women had experienced some form of abuse in their life. In all cases their husband or partner was most likely to be the perpetrator. These findings are consistent with those of Malawi's 2010 DHS, briefly presented in section 4.6.1.3 (22).

	Yes		No	
Experience of abuse	**Freq.**	**Percent.**	**Freq.**	**Percent.**
Ever been abused	887	22.4%	3,081	77.6%
Been abused in the last year	283	7.1%	3,682	92.9%
Been abused while pregnant	151	3.8%	3,815	96.2%
Been forced to do something sexual	79	2.0%	3,878	98.0%
Afraid of a person who has abused her	332	33.5%	660	66.5%

Table 7-2 Women's experience of physical, emotional and sexual abuse

7.4.2 Support and Control

60% of women said that they had at least one person with whom to share their worries and concerns. This tended to be either her mother or another relative such as her sister. Women were asked how much control they felt they had over important decisions affecting their health or their children's health. 65.2% of women reported having control over none or only a few decisions affecting their health or the health of their children.

7.4.3 Food security

Food security was a later addition to the questionnaire as noted in section 4.6.1. Owing to this there were missing data for just over a third of women. Women were asked to what extent they thought they had enough food to eat. Only 16.2% of women said that they 'mostly' or 'always' had enough food to eat; just over half said that they 'never' or 'rarely' had enough to eat, showing that food insecurity is a very common problem in Mchinji District.

7.4.4 MaiMwana interventions

A previous cluster randomised controlled trial in Mchinji District had used a factorial design to assess the effect of women's groups, infant feeding counsellors or both on maternal and neonatal health outcomes compared to no intervention (327). Although this trial officially finished in 2010, some women's groups and infant feeding counsellors have continued. As these interventions could influence pregnancy intention, care-seeking behaviours,

breastfeeding practices and other outcomes of interest to this research, women were asked whether or not they had received these interventions.

6.1% of women had ever attended a women's group and an infant feeding counsellor had visited 15.6%. These low numbers reflect the fact that we were covering control areas as well as intervention areas, in addition to the fact that the trial had finished almost four years ago.

7.5 Obstetric history

Women's obstetric history is shown in Table 7-3. Including the current pregnancy, women reported up to 15 pregnancies (median three) and 12 previous births (median two), with 11.9% of women reporting at least one miscarriage. We do not know whether these were spontaneous miscarriages or induced abortion (which is illegal in Malawi) and this is a limitation of this research. While some women had given birth 12 times previously, the highest number of living children was nine due to previous stillbirths (5.33% of women had experienced at least one stillbirth) and deaths of children at any age (which 19.7% of women had experienced at least once). Over a third of the women who were currently pregnant (34.4%) had given birth within the last 24 months, although the median time since the last birth was three years.

Obstetric history					
	Freq.	Percent.		Freq.	Percent.
Number of pregnancies			**Previous miscarriage**		
First	1,172	27.6	None	3,739	88.1
2nd - 3rd	1,402	33.0	1	391	9.21
≥ 4	1,671	39.4	≥ 2	114	2.67
Range (median)	1-15 (3)		Range (median)	0-6 (0)	
Number of previous births			**Previous stillbirth**		
None	1,240	29.2	None	4,018	94.7
1-2	1,423	33.5	1	198	4.66
≥ 3	1,581	37.3	≥ 2	28	0.66
Range (median)	0-12 (2)		Range (median)	0-4 (0)	
Time since last birth (n=2,995)			**Previous child death (any age)**		
< 24 months	1,029	34.4	None	3,409	80.3
2-3 years	884	29.5	1	601	14.2
3-4 years	536	17.9	≥ 2	234	5.5
4-5 years	270	9.02	Range (median)	0-6 (0)	
> 5 years	275	9.18			
Range (median)	7-264 (36)				
Number of living children					
None	1,352	31.9			
1	850	20.0			
2	659	15.5			
3	568	13.4			
4	407	9.59			
≥ 5	408	9.61			
Range (median)	0-9 (1)				

Table 7-3 Obstetric history characteristics of the women interviewed antenatally

As women's age increased so did the number of live children that they had and the chance that they had experienced at least one child death, a stillbirth or a miscarriage (all $p<0.001$), as would be expected with cumulative outcomes. Women having their first child were significantly younger than those having their second or subsequent child (18.9 versus 27.7 years, $p<0.001$). Married women had, on average, one more child than unmarried women (1.93 versus 0.93, $p<0.001$).

Increasing level of education was negatively correlated with number of live children; women with no education had 3.22 children on average whereas

those with secondary education had 1.03 children on average. This relationship remained significant after adjusting for age and marital status demonstrating the importance of education in reducing overall family size, as has been widely noted in the literature (96, 344-346).

7.5.1 Gestation

Women were asked when their last menstrual period was and this was used to calculate their estimated delivery date and the date after which they should be visited for the postnatal interview. Using the antenatally reported date of last menstrual period, women were between two and nine months pregnant (median six, mean 5.98) when interviewed.

7.6 Distance to nearest health facility

There are 14 health facilities in Mchinji District and one private hospital, St Gabriel's Hospital, just outside the district (see Map 7-2). There is one district hospital, one mission hospital, three community hospitals and nine health centres ('HC' on the map).

Women lived an average of 5.90km from their nearest health facility (standard deviation 3.02km). The distances ranged from less than 100m to a maximum of 15.8km.

Map 7-2 Location of health facilities in Mchinji District

7.7 Maternal mental health status

7.7.1 Previous depression

Women who said that they had experienced periods of feeling down or having little interest in things were considered to have had a previous episode of possible depression, particularly if these periods lasted for more than two weeks, as was explained in Table 4-3. Of the 4,221 women (99.5%) who gave useable answers to questions about previous depression most women (70.6%) reported no episodes of possible depression in the year before they became pregnant, as shown in Table 7-4. 29.4% of women had experienced possible symptoms of depression in the year prior to their current pregnancy and in almost half of these women the episode lasted for more than two weeks.

Symptoms of depression in the year prior to pregnancy	Freq.	Percent.
None	2,980	70.6
One or two, < 2 weeks	651	15.4
One ≥ 2 weeks	537	12.7
Both ≥ 2 weeks	53	1.26
Total	**4,221**	**100**

Table 7-4 Women's report of possible episodes of depression in the last year

Prevalence of reported previous episodes of possible depression increased with increasing age (p=0.016). Unmarried women were more likely to report one or more previous episodes of depression than married women (18.9% v 13.6%, p=0.023) but this difference was not significant once stratified for age. There was no relationship between education level and previous depression.

7.7.2 Antenatal mental health status

Women's responses to each of the World Health Organization's (WHO) Self-Reporting Questionnaire (SRQ) questions, using the non-imputed data, are shown in Table 7-5.

SRQ questions	No (%)	Yes (%)
Do you often have headaches?	56.2	43.8
Is your appetite poor?	65.5	34.6
Do you sleep badly?	61.8	38.2
Do your hands shake?	86.7	13.3
Do you feel nervous, tense or worried?	57.3	42.7
Are you easily frightened?	84.9	15.1
Is your digestion poor?	82.7	17.3
Do you have trouble thinking clearly?	80.1	19.9
Do you feel unhappy?	70.5	29.5
Do you cry more than usual?	91.3	8.70
Do you find it difficult to enjoy your daily activities?	78.2	21.8
Do you find it difficult to make decisions?	85.9	14.1
Is your daily work suffering?	81.0	19.0
Are you unable to play a useful part in life?	83.9	16.1
Have you lost interest in things?	78.7	21.3
Do you feel that you are a worthless person?	87.9	12.1
Has the thought of ending your life been on your mind?	93.3	6.70
Do you feel tired all the time?	57.9	42.1
Do you have uncomfortable feelings in your stomach?	51.9	48.2
Are you easily tired?	58.3	41.7

Table 7-5 Women's responses to the WHO SRQ questions during pregnancy

The distribution of SRQ scores, now using the data with the missing values imputed, is shown in Figure 7-2. Pregnant women's antenatal SRQ scores ranged from zero to 19 (median four, inter-quartile range two to seven). Just 8.36% of women reported no symptoms and, using the cut-point of 7/8 used by Stewart et al. (313), over 23% of women screened positive for minor or major depression. Whilst not diagnostic this does demonstrate the high burden of mental health problems during pregnancy.

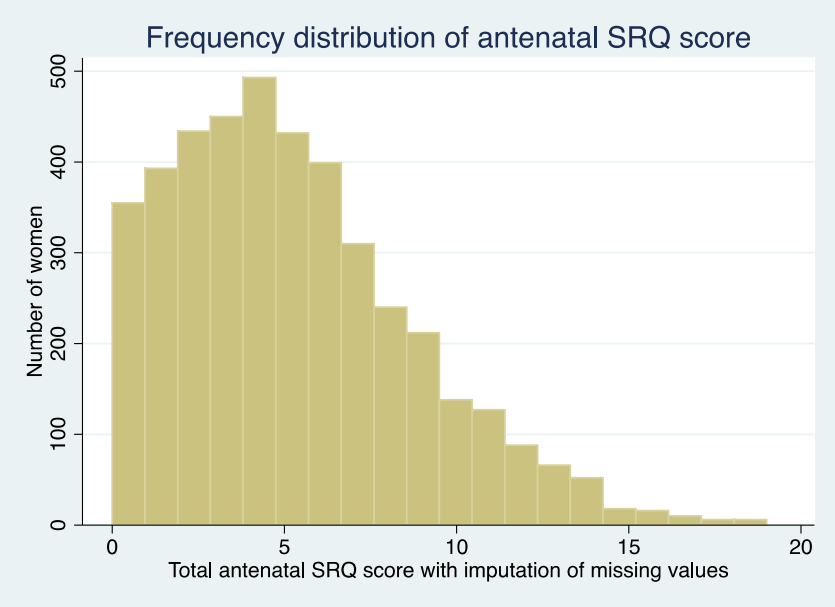


Figure 7-2 Distribution of antenatal SRQ scores

SRQ scores were lower in the 18-29 age group (mean 4.91) than either the 15-17 (mean 5.40) or over 29 age groups (mean 5.35), a difference that was statistically significant (p=0.001). Unmarried women had higher SRQ scores than married women (mean 6.09 versus 4.97, p<0.001). SRQ scores also decreased with increasing level of education (mean SRQ score for women with no education 5.48, compared to 5.07, 4.73 and 3.30 for women with primary, secondary or tertiary education respectively, p=0.015).
These findings are consistent with those noted in the literature in section 3.3.3.6, i.e. that antenatal mental health is associated with age, marital status and education (217, 222, 225, 226, 232).

7.7.3 Suicidality

As described in section 4.6.1.1, women who answered 'yes' to the question about suicide were asked three additional questions: whether they thought about it all the time, whether they had thought of a method and whether they had actually tried to commit suicide. 283 (6.67%) women did answer yes to thinking about suicide and were asked these questions; their responses are shown in Table 7-6. Almost half (45.6%) answered yes to one of the additional suicide questions and 13.8% answered yes to two or more. These figures reinforce the importance of maternal mental health as a significant cause of maternal morbidity and, potentially, mortality.

Total number of yes answers to suicidality questions			
	Freq.	**Percent.**	**Percent. of 4,244**
None	115	40.6	2.71
One	129	45.6	3.04
Two	36	12.7	0.848
Three	3	1.06	0.071
Total	**283**	**100**	**6.67**

Table 7-6 Women's response to questions on suicidality

7.8 Antenatal pregnancy intention

Pregnancy intention was assessed antenatally using the six-question London Measure of Unplanned Pregnancy (LMUP) that indicates the degree of intention of the pregnancy. Each question scores zero, one or two giving a total score in the range of zero to 12, with 12 being a highly planned pregnancy and zero being the most unplanned pregnancy. Here I consider the responses to each question before examining the distribution of the total score and comparing this with data from the UK.

7.8.1 Responses to each LMUP question

In Table 7-7 the responses to each question on the LMUP are shown using the non-imputed data. For questions one to five the more planned option was the most frequently endorsed, whereas for question six, pre-pregnancy preparations, a lack of pre-pregnancy preparation was most common.

Antenatal response to LMUP questions	Freq.	Percent.
LMUP question one		
Always used contraception	230	5.42
Sometimes used contraception/ knew the method failed	1,187	28.0
Not using contraception	2,823	66.6
Total	**4,240**	**100**
LMUP question two		
Wrong time	1,460	34.6
Ok, but not quite right time	431	10.2
Right time	2,344	55.2
Total	**4,243**	**100**
LMUP question three		
Did not intend to get pregnant	1,628	38.4
Intentions kept changing	310	7.31
Intended to get pregnant	2,304	54.3
Total	**4,242**	**100**
LMUP question four		
Did not want to have a baby	1,438	33.9
Mixed feelings about having a baby	462	10.9
Wanted to have a baby	2,344	55.2
Total	**4,244**	**100**
LMUP question five		
Never discussed having children together	970	22.9
Discussed having children, but had not agreed to get pregnant	1,011	23.8
Agreed we would like me to be pregnant	2,261	53.3
Total	**4,242**	**100**
LMUP question six		
No action to prepare for pregnancy	2,710	64.0
One action to prepare for pregnancy	1,055	24.9
Two or more actions to prepare for pregnancy	469	11.1
Total	**4,234**	**100**

Table 7-7 Women's responses to the six questions on the LMUP asked during pregnancy

7.8.2 Pre-pregnancy preparations

LMUP question six asked women to indicate what pre-pregnancy preparations they had made, if any (see LMUP questions in Box 2-4). Of all

the women who responded to this question most (64%) said that they had taken no actions to prepare for pregnancy, meaning 36% of women had undertaken at least one pre-pregnancy preparation. The possible actions were: took iron/folic acid, ate more healthily, saved money, sought healthcare advice or took some other action, which they were then asked to specify. Table 7-8 shows that the most common pre-pregnancy preparation was eating more healthily, with almost 72% of the women who took at least one pre-pregnancy action reporting this. Saving money was second most common (36.9%) with taking iron/folic acid third at 18.2%.

Pre-pregnancy preparations reported by women on LMUP question six					
	Freq.	**Percent.**		**Freq.**	**Percent.**
Took iron/folic acid before pregnancy			**Sought health advice before pregnancy**		
No	1,247	81.8	No	1,379	90.5
Yes	277	18.2	Yes	145	9.50
Total	**1,524**	**100**	**Total**	**1,524**	**100**
Ate more healthily before pregnancy			**Did something else in preparation for pregnancy**		
No	429	28.1	No	1,498	98.3
Yes	1,095	71.9	Yes	26	1.70
Total	**1,524**	**100**	**Total**	**1,524**	**100**
Saved money before pregnancy					
No	962	63.1			
Yes	562	36.9			
Total	**1,524**	**100**			

Table 7-8 Actions taken by women in preparation for becoming pregnant

26 women said that they took some action other than those on the list. Inspection of the further information they gave for this question showed that 11 referred to eating specific foods, particularly fruits and vegetables, and ten said that they had taken traditional medicines (with one specifying that this was to prevent miscarriage). For the remaining five, two reported exercising and one each said that they had used Western medicine, bought some things for the baby or used family planning. The small number reporting 'other' preparations is reassuring in that it does not seem that the pre-

specified options were missing an important behaviour. This is particularly the case as the two most common answers (eating specific foods and taking traditional medicines) could in fact have been classified according to the pre-specified options of 'ate more healthily' and 'sought health advice'.

7.8.3 Distribution of total LMUP score

The pregnant women interviewed in Mchinji District reported scores from zero to 12, reflecting the full range of intention. The distribution of pregnancy intention is shown in Figure 7-3, which clearly indicates a bi-modal distribution. The imputed antenatal LMUP data were used for this analysis.

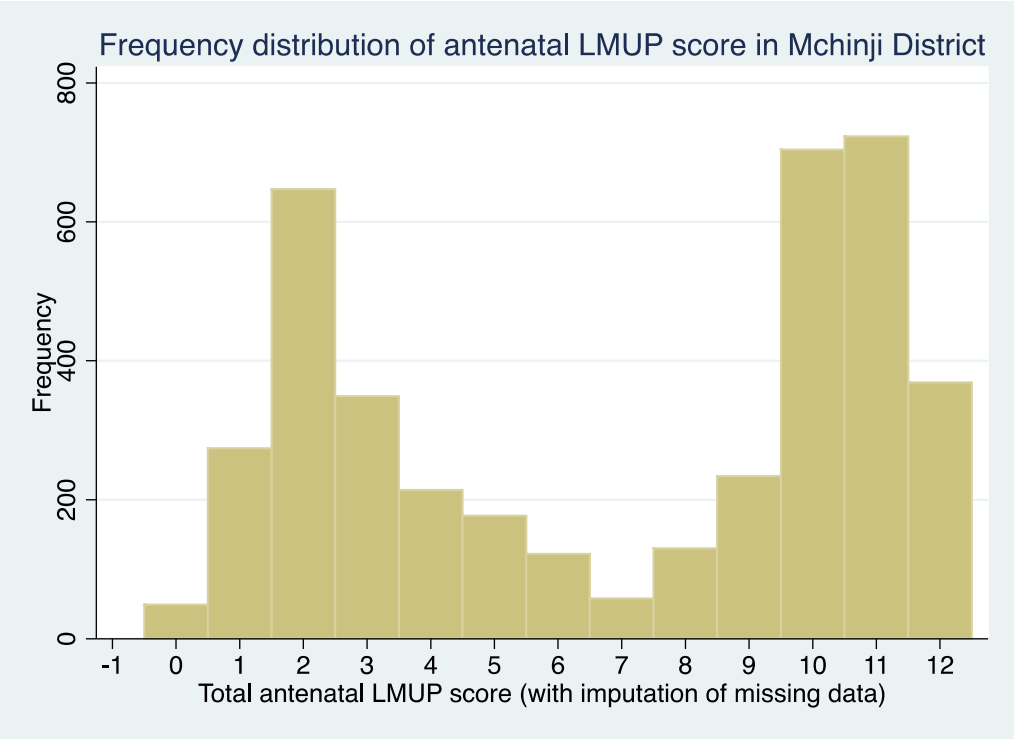


Figure 7-3 Frequency distribution of antenatal LMUP score in Mchinji District

The bi-modal distribution seen in Mchinji District is similar to, but more marked than, that seen in the UK, which is shown in Figure 7-4 (created, with permission, from Dr Barrett's raw data). In both there is a peak at a score of two, though it is larger in the Mchinji data, and in the Mchinji data the second peak is at 11 whereas the UK data's second peak is at 12.

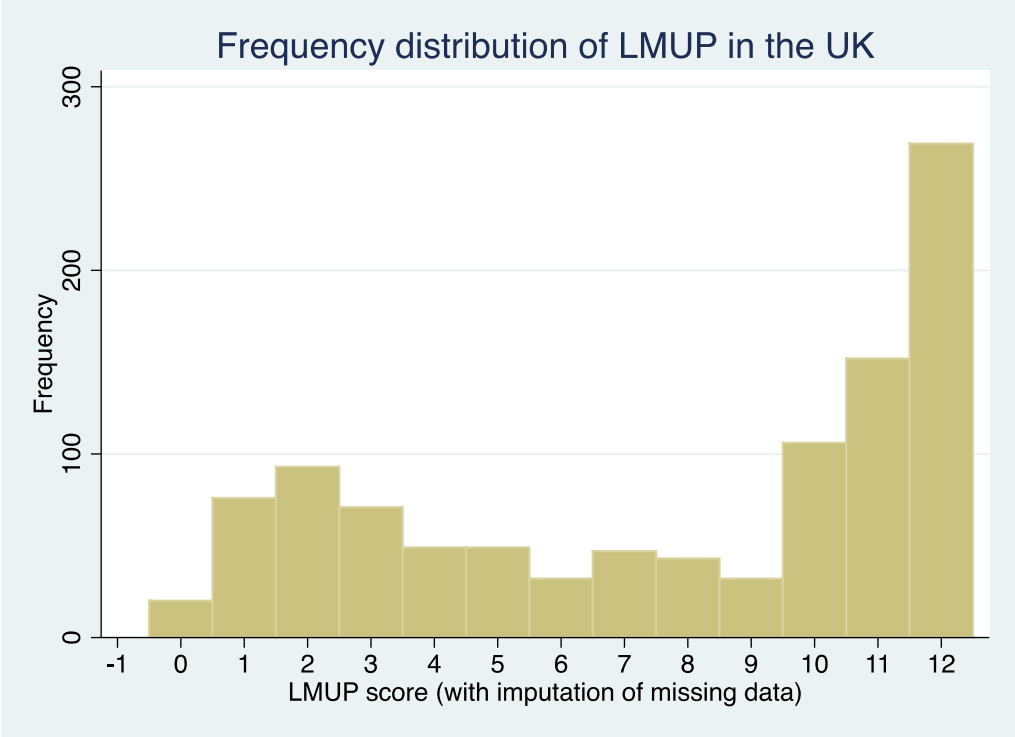


Figure 7-4 Frequency distribution of LMUP score in the UK

For estimating the prevalence of unintended pregnancy, cut-points have been suggested to divide the LMUP scores into categories of 'unplanned' (0-3), 'ambivalent' (4-9) and 'planned' (10-12) (8). While not recommended for analysis they can be used to compare the Mchinji and UK distributions of pregnancy intentions, as shown in Table 7-9.

Categorisation of LMUP scores				
	UK data		Mchinji data	
	Freq.	Percent.	Freq.	Percent.
Unplanned (0-3)	180	27.7	1,363	32.1
Ambivalent (4-9)	150	23.0	979	23.1
Planned (10-12)	321	49.3	1,902	44.8
Total	**651**	**100**	**4,244**	**100**

Table 7-9 Comparison of the distribution of pregnancy intention in the UK and Mchinji District

The categorisation of pregnancies in this way shows marked similarities between the UK and Mchinji data. The proportion falling into the 'ambivalent' category is almost identical and there is just 4.5% difference in the proportion of planned and 4.4% in the proportion of unplanned with Mchinji District

having the higher proportion of unplanned pregnancies. This difference was of borderline statistical significance (p=0.049) and the observed differences in the proportions are small suggesting that in terms of the distribution of pregnancy intention, as measured by the LMUP, there is not a major difference between the UK and Mchinji District.

7.8.4 Validity of the LMUP

In the validation of the Chichewa LMUP it was noted that question one, which asks about contraceptive use, was less strongly correlated with the total LMUP score than the other questions, with an item-rest correlation coefficient of just 0.05 (section 6.3.3). Despite this, a decision was made to retain this item. This appears justified as in the antenatal data the item-rest correlation coefficient for question one has increased to 0.283. The item-rest correlation for question six also increased from 0.16 to 0.504, as shown in Table 7-10. Questions one and six are the behavioural components of pregnancy intention; their lower item-rest correlations than other question are consistent with the discussion in section 2.2.5 about the weak relationships seen between intentions and behaviour.

Item-test and item-rest correlations for the antenatal LMUP data			
	Freq.	Item-test correlation coefficient	Item-rest correlation coefficient
1 - Contraception	4,241	0.416	0.283
2 - Timing	4,244	0.926	0.878
3 - Intention	4,243	0.940	0.899
4 - Desire	4,245	0.934	0.891
5 - Partner	4,243	0.874	0.809
6 - Preparation	4,235	0.627	0.504

Table 7-10 Item-test and item-rest correlations in the full antenatal LMUP data

The Cronbach's α, a measure of the internal consistency of the scale, increased from 0.78 to 0.89. A principal components analysis of the antenatal data confirmed that all items loaded onto one component with an Eigenvalue of 3.95 (data not shown). These larger, community-based data

confirm the validity of the LMUP found in the smaller, health facility based data.

7.9 Partner's intention

Women were asked whether they thought that their partner had wanted them to become pregnant or not, or whether their partner had had mixed feelings about it. Their responses are shown in Table 7-11. The percentage of women who reported that they thought that their partner wanted the pregnancy (62.5%) is higher than the percentage of women who report their own pregnancy as intended. This is true for either the woman's LMUP score as a whole (44.9% planned, Table 7-9) or her response to question four of the LMUP, which is whether there had been a discussion with her partner about whether to have a child (53.3%, Table 7-7).

Partner's pre-conception intention as reported by the woman		
	Freq.	**Percent.**
Partner did not want	1,019	25.9
Partner mixed feelings	457	11.6
Partner wanted	2,463	62.5
Total	**3,939**	**100**

Table 7-11 Women's report of their partner's pregnancy intention

There was a strong correlation between the woman's LMUP score and her report of her partner's intention (Pearson's correlation coefficient 0.79). Comparing the woman's grouped LMUP score with the partner's reported intention in Table 7-12, it was more common for women to report their partner's intention to be higher than their own; 22.2% of women did this compared to just 3.53% who reported their intentions to be higher than their partner's.

	Partner			
	Unplanned	Ambivalent	Planned	**Total**
Woman	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**
Unplanned	898 (22.8)	157 (3.99)	201 (5.1)	1,256 (31.9)
Ambivalent	118 (3.0)	285 (7.24)	510 (13.0)	913 (23.2)
Planned	3 (0.08)	15 (0.38)	1,752 (44.5)	1,770 (44.9)
Total	**1,019 (25.8)**	**4,57 (11.6)**	**2,463 (62.5)**	**3,939**

Table 7-12 Comparison of women's grouped LMUP score with her report of her partner's intention

While women report their partner's intentions to be aligned with theirs in almost 75% of cases, the fact that so many report their partner's intentions to be higher than their own may indicate power imbalances within the relationship. Alternatively, since men were not asked directly it could be that there was misperception by the women of their partner's views. Another explanation could be misclassification as women were only given three options for their partner's intention: wanted, mixed feelings or unwanted.

7.10 Chapter summary

This Chapter has explored the characteristics of the women recruited into the cohort and interviewed antenatally. Their socio-economic and demographic characteristics have been described, as well as their obstetric histories and previous and current mental health status. Finally, we have seen the antenatal distribution of the pregnancy intention scores from the LMUP and how this compares with the UK. The next Chapter will analyse the relationships between the women's characteristics and their antenatal LMUP scores and develop a multivariate hierarchical model for the determinants of pregnancy intention in Mchinji District.

Chapter 8 Determinants of pregnancy intention

The last Chapter described the pregnant women in Mchinji District who were recruited into the cohort in terms of their socio-demographic, obstetric and other factors and their degree of pregnancy intention on the London Measure of Unplanned Pregnancy. These factors were considered on the basis of the literature discussed in sections 3.3.4 and 3.3.5.9. In this Chapter I explore the associations between these factors and pregnancy intention in univariate analyses as per the hypotheses in Table 5-1. This analysis is then taken forward to develop a hierarchical multivariate linear regression model.

A higher score on the LMUP indicates a more planned pregnancy. In this Chapter I use the phrases such as 'higher pregnancy intention', 'more planned pregnancy' and 'higher median LMUP score' (and their opposites) as synonyms.

All the analyses are conducted using imputed values for missing data in the antenatal LMUP and antenatal SRQ as described in section 5.2.

8.1 Univariate analysis results

8.1.1 Socio-economic status

For socio-economic status (SES) it was hypothesised that women of higher SES would tend to have higher LMUP scores (more planned pregnancies) than women of lower SES. This was indeed the case, with a Kendall's tau p-value of $p<0.0001$, but the relationship was most marked across the bottom three quintiles with little difference between the highest quintiles, as demonstrated in Table 8-1.

LMUP score by socio-economic status quintile				
SES quintile	**Freq.**	**Median**	**IQR[xxiii]**	**Mean**
Poorest 20%	839	7	2-10	6.50
Second-poorest 20%	839	8	3-10	6.85
Middle 20%	838	9	3-11	6.97
Next-richest 20%	839	9	3-11	7.24
Richest 20%	835	9	3-11	7.33
Total	**4,190**	**9**	**3-11**	**6.98**

Table 8-1 Table of LMUP score by SES quintile

8.1.2 Mother's age

I hypothesised that women aged 15-17 and those over 30 would have lower pregnancy intention scores than women aged 18-29. I used 15-17 instead of 15-19, which was used in the LMUP validation, because 75% of women are married by 20, mostly between 18 and 20 (22), which is likely to affect their pregnancy intention. The hypothesis testing in the LMUP validation was still significant if 15-17 was used but there were very few women aged 15-17 in the small validation sample hence 15-19 was used in that analysis.

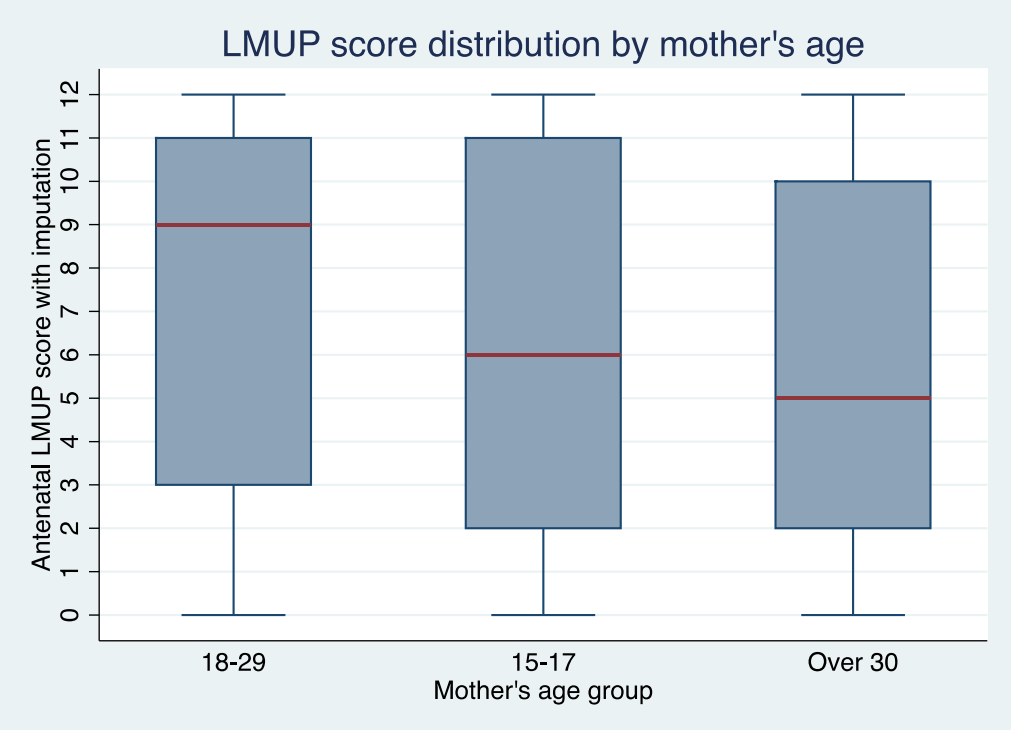


Figure 8-1 Box and whisker plot of LMUP score distribution by mother's age group

[xxiii] IQR stands for inter-quartile range.

Figure 8-1 shows that, while women in every age group had pregnancies scoring from zero to 12, women in the 18-29 age group had a median LMUP score of nine compared to six and five in the 15-17 and over 30 age groups respectively. The Kruskal-Wallis test was significant at p=0.0001, confirming that women aged 15-17 and those aged over 30 have lower pregnancy intention scores than women aged 18-29.

8.1.3 Father's age

Father's age was hypothesised to have the same U-shaped relationship with the woman's LMUP score as mother's age. Given that the fathers were, on average, older than the women, a different cut-point was used at the lower age range of 15-19 instead of 15-17. Women whose partners were aged 20-29 did indeed have a higher median LMUP score (ten) than those whose partners were aged 15-19 (three) or over 30 (seven), as seen in Table 8-2, and this was significant at p=0.0001 on the Kruskal-Wallis test.

Kruskal-Wallis equality-of-populations rank test				
Father's age group	**Freq.**	**Median**	**Mean**	**Rank Sum**
20-29	2,128	10	7.54	4640000
15-19	143	3	5.52	232570.5
≥ 30	1,800	7	6.56	3410000
Total	**4,071**	**9**	**7.04**	-

Table 8-2 Table of LMUP scores by father's age group

8.1.4 Mother's education level

It was expected that as a mother's level of education (in years) increased, the reported intention of her pregnancy would also increase. This was broadly the case, as shown in Figure 8-2 which plots the median LMUP score for women by the number of years of education they had completed. The Kendall's tau was significant at p<0.0001, confirming that increasing mother's education is associated with increasing LMUP score.

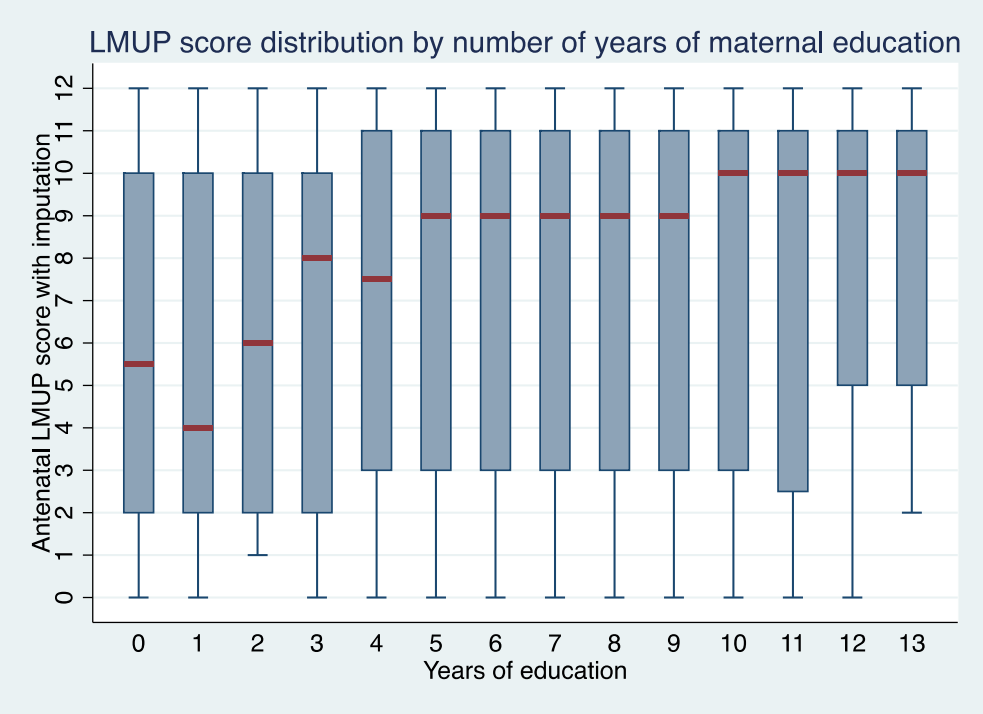


Figure 8-2 Box and whisker plot of LMUP score distribution by mother's education level

8.1.5 Father's education level

Maternal LMUP score was expected to increase as the father's education level increased and this was also broadly the case, as shown in Figure 8-3.

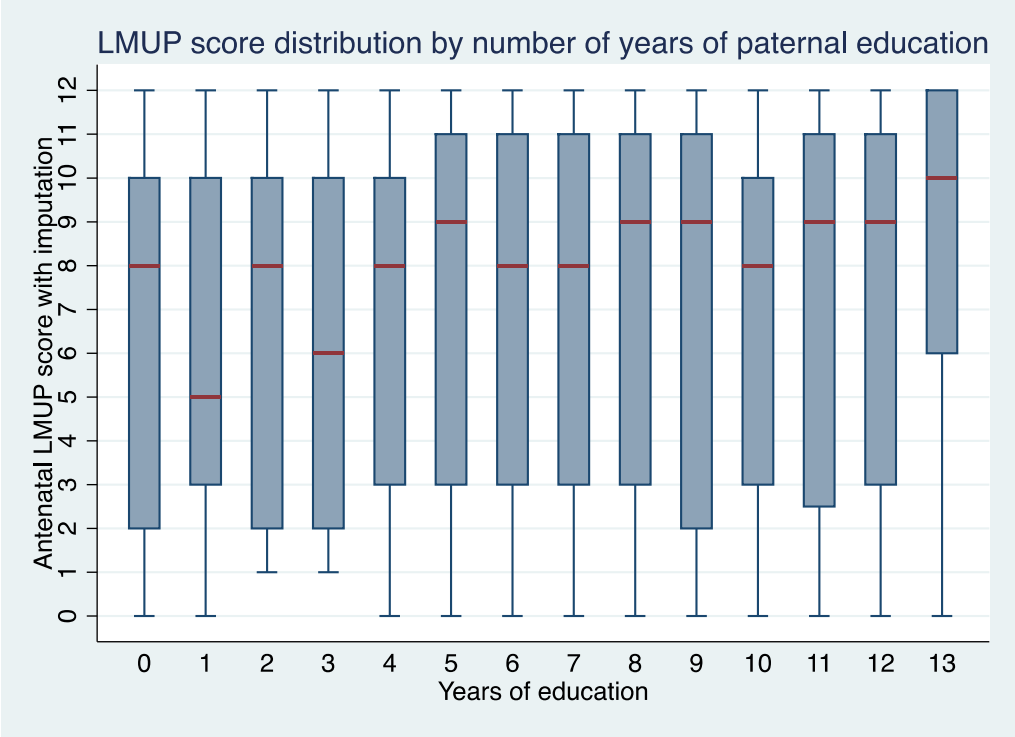


Figure 8-3 Box and whisker plot of LMUP score distribution by father's education level

The relationship was less obvious than that for maternal education, with some higher median LMUP scores at the lower levels of paternal education than were expected. Nevertheless, the Kendall's tau was significant at p=0.0001, indicating that increasing level of paternal education is associated with increasing maternal LMUP score.

8.1.6 Marital status

As per the LMUP validation and published literature (sections 6.1.1 and 3.3.4) it was anticipated that women who were unmarried would report their pregnancies as less intended. This was clearly the case as unmarried women had a median LMUP score of two and married women of nine as shown in Figure 8-4. This was significant at p<0.0001 on the Kendall's tau test.

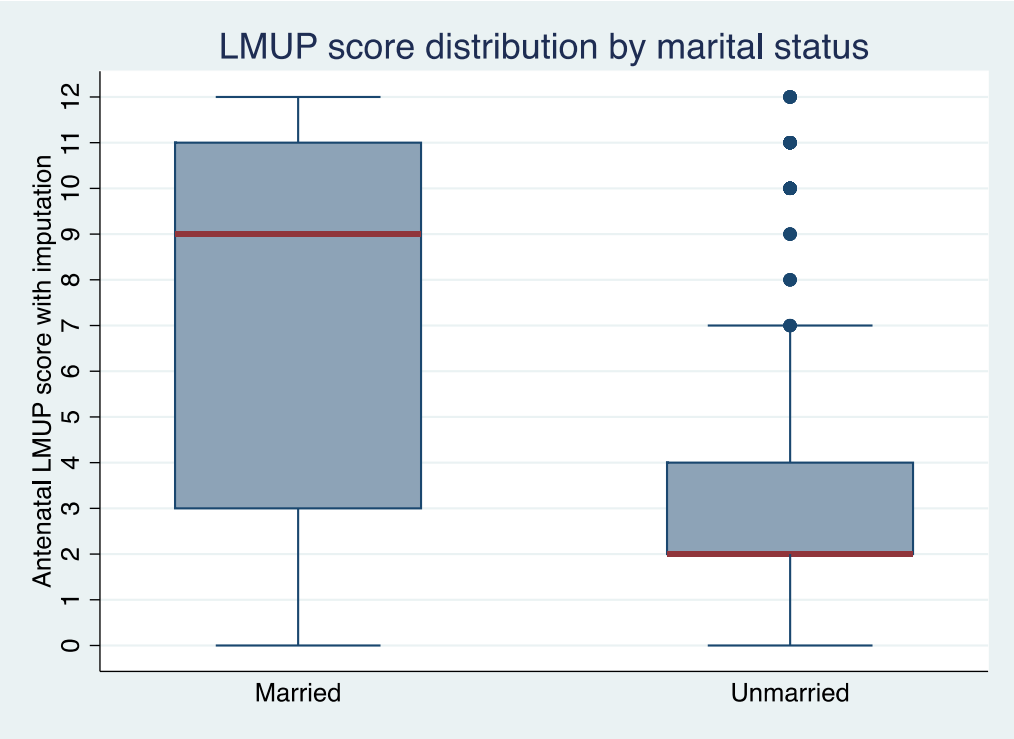


Figure 8-4 Box and whisker plot of LMUP score distribution by marital status

8.1.7 Number of live children

The number of live children each woman had was expected to be negatively correlated with the intention of her pregnancy, in that those with more children would report lower levels of intention for their current pregnancy. Figure 8-5 clearly shows this to be true and again this was significant at p=0.0001 on the Kendall's tau test.

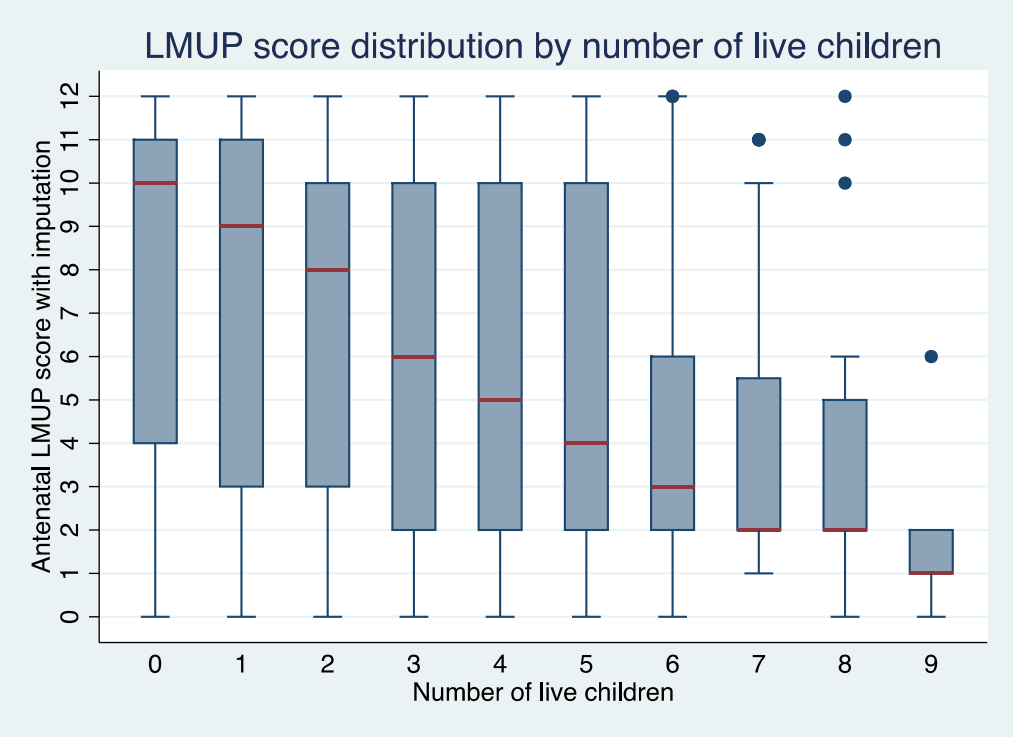


Figure 8-5 Box and whisker plot of LMUP score distribution by number of live children

8.1.8 Primigravida

Women who were having their first pregnancy (known as primigravida or primips) were expected to have a higher median LMUP score than those who were having their second or subsequent pregnancy (known as multigravida or multips). This was confirmed, as primips' median LMUP score was ten (seen in Figure 8-5 above) compared to multips median LMUP score of seven, a difference that was significant at p <0.0001 on the Kendall's tau test.

Two subsets of primips had very different LMUP scores: unmarried women and women aged under 18. Unmarried women had a median LMUP score of

two (IQR 2-3) compared to ten (IQR 8-11) in married women (p<0.001) and women aged under 18 had a median LMUP score of five (IQR 2-11) compared to ten (IQR 5-11) in those aged 18-29 (p<0.001).

8.1.9 Birth interval

The birth interval is the time since the woman last gave birth. For the purposes of analysis this continuous variable was grouped into time periods of less than two years, two-three years, three-four years, four-five years and more than five years. Short birth intervals of less than 24 months and birth intervals of more than five years were hypothesised to be associated with lower LMUP scores giving a U-shaped relationship. However, the data revealed this not to be the case and, in fact, LMUP score increased as the birth interval increased, as shown in Figure 8-6. The Kruskal-Wallis test was therefore replaced, *post-hoc*, by Kendall's tau which confirmed a statistically significant association at p<0.0001.

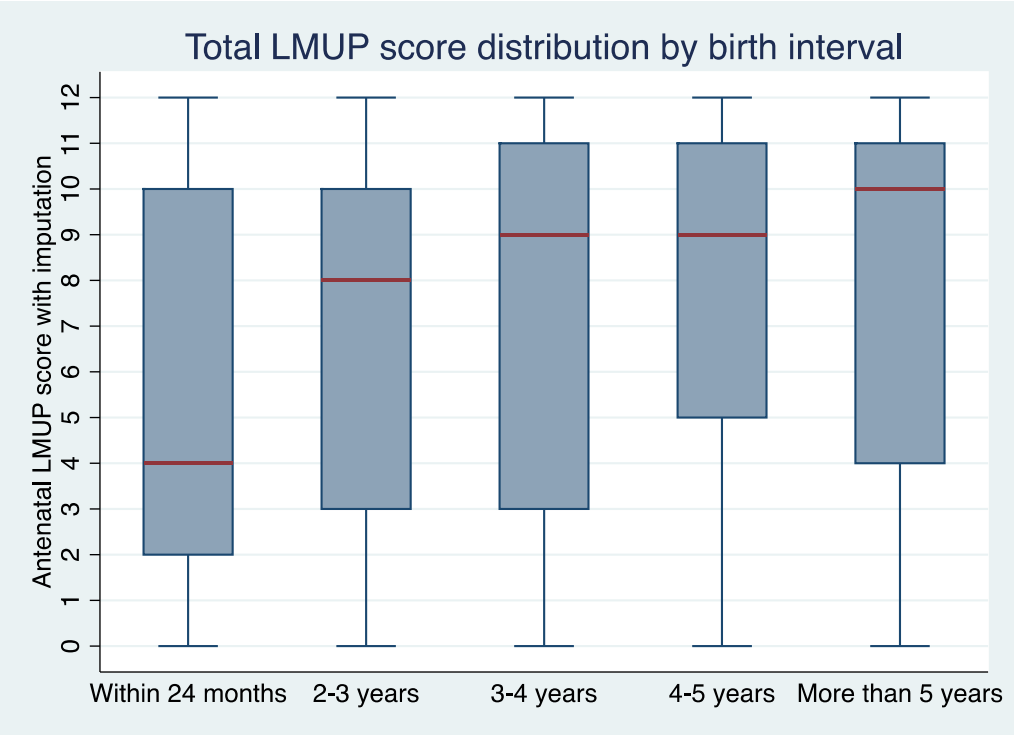


Figure 8-6 Box and whisker plot of LMUP score distribution by birth interval

As described in section 5.1.4, primigravida and birth interval were combined into one variable for the multivariate analysis to account for the collinearity between them.

8.1.10 Gestation

Women who were interviewed later in pregnancy (on the basis of their self-reported last menstrual period) had lower median LMUP scores than those who were interviewed earlier, as shown in Figure 8-7. This is contrary to the original hypothesis. The exception is those who were interviewed at two month's gestation, although this should be viewed with caution as this gestation may not be correct. The p-value from the Kendall's tau for this relationship was statistically significant at p=0.0143.

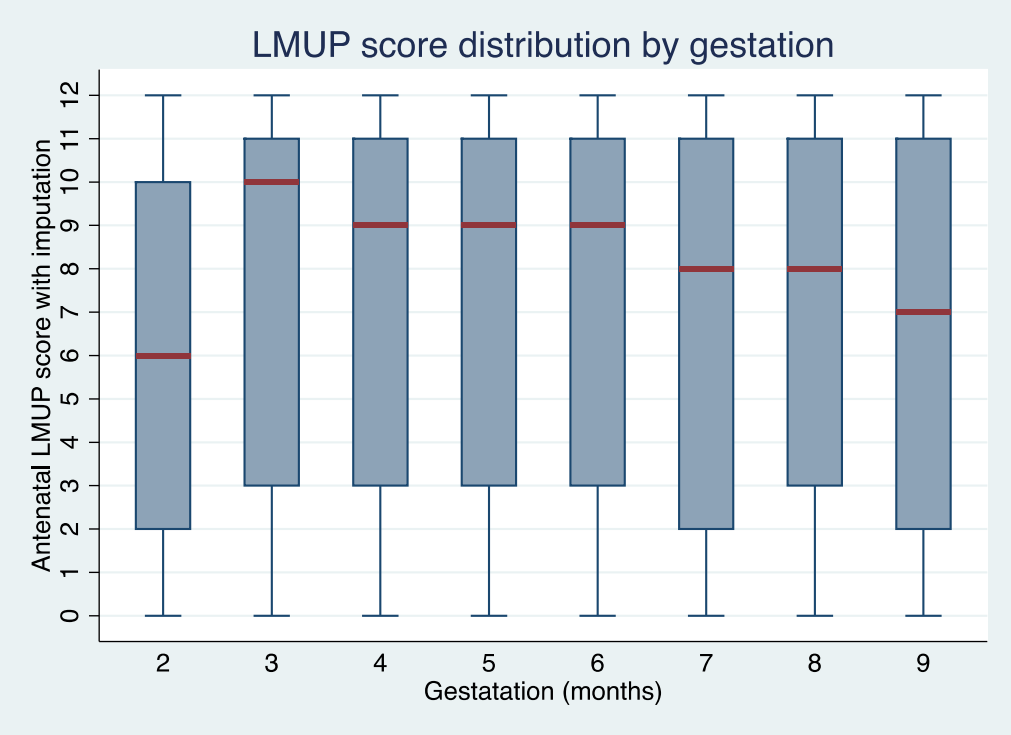


Figure 8-7 Box and whisker plot of LMUP score distribution by gestation at antenatal interview

8.1.11 Previous depression

It was anticipated that an increasing level of possible previous depression would be associated with lower pregnancy intention. Previous episodes of possible depression were defined by women saying that they had experienced periods of feeling down or having little interest in things and whether these had lasted for more than two weeks, as explained in Table 4-3. Figure 8-8 shows that women who had experienced any episode of possible depression, regardless of its duration, had a statistically significantly lower median LMUP score than women who had never had such an episode

(Kendall's tau p<0.0001). Where episodes lasted for more than two weeks, there was little difference in LMUP scores between those who reported only either feeling down or having little interest in things and those who reported both of these.

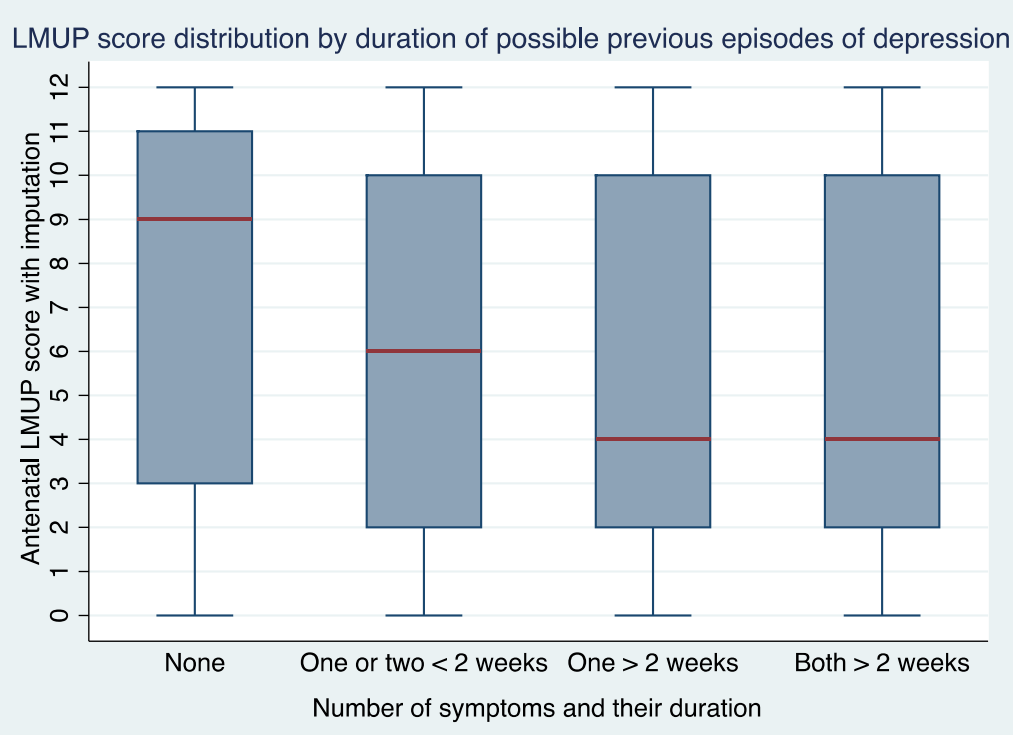


Figure 8-8 Box and whisker plot of LMUP score distribution by previous episodes of possible depression

8.1.12 Distance to health facility

The further away from a health facility the woman is the lower her LMUP score was expected to be. This was because it was assumed that distance would be a barrier to her actualising her intentions given the greater difficulty in accessing family planning due to the time and financial and opportunity costs of getting to the clinic. Although LMUP score did decrease slightly with increasing distance to the health facility this was not statistically significant (Kendall's tau p=0.42).

8.1.13 Religion

The Kruskal-Wallis test was not significant (p=0.225) indicating no evidence for a relationship between religion and pregnancy intention, as was hypothesised.

8.1.14 Tribe

As with religion, no particular relationship between tribe and pregnancy intention was expected. However, the Kruskal-Wallis test p-value of p=0.001 suggests that there is a relationship. Table 8-3 shows the median and inter-quartile range of LMUP score by tribe. The Chewa tribe, who make up 85% of the population in Mchinji District, dominates this analysis but it appears that women from the Ngoni tribe have lower LMUP scores and Senga women have slightly higher LMUP scores.

Kruskal-Wallis equality-of-populations rank test					
Tribe	**Freq.**	**Median**	**IQR**	**Mean**	**Rank Sum**
Chewa	3,597	9	3-11	6.91	7540000
Ngoni	281	6	2-10	6.57	572007.5
Senga	207	11	4-11	8.26	538546
Yao	92	8	3-11	7.16	203811.5
Other	67	10	3-11	7.54	153812.5
Total	**4,244**	**9**	**3-11**	**6.97**	

Table 8-3 Table of LMUP scores by tribe

8.1.15 Intimate Partner Violence

Experiencing any one of the forms of abuse was associated with a statistically significantly lower median LMUP score, as shown in Table 8-4, all at p<0.001 on Kendall's tau. This confirms that experience of abuse is associated with lower pregnancy intention. The difference in median LMUP score in women who were and were not afraid of the person who had abused them was not significant (p=0.132). Therefore, among those who were abused there is no additional statistically significant effect of fearing the abuser on pregnancy intention.

Experience of abuse	Yes			No		
	Freq.	Percent.	Median	Freq.	Percent.	Median
Ever been abused	887	22.4%	5	3,081	77.6%	9
Been abused in the last year	283	7.1%	4	3,682	92.9%	9
Been abused while pregnant	151	3.8%	5	3,815	96.2%	9
Been forced to do something sexual	79	2.0%	4	3,878	98.0%	9
Afraid of person who has abused her	332	33.5%	4	660	66.5%	5

Table 8-4 Table of LMUP scores by previous experience of abuse

8.1.16 Support and Control

There was no difference in LMUP score between women who said that they had support and those who said that they did not (Kendall's tau p=0.226). Similarly there was no difference in LMUP score between women who said that they had control over at least some decisions compared to those who said that they had control over no decisions (Kendall's tau p=0.154). As these tests were not significant there is little evidence of a relationship between either support or control and pregnancy intention.

8.1.17 Food security

The Kendall's tau was not significant (p=0.604) indicating little evidence for a relationship between food security and pregnancy intention.

8.1.18 MaiMwana interventions

The Kendall's tau was not significant for either having attended a women's group (p=0.475) or having seen an infant feeding counsellor (p=0.618) indicating little evidence for a relationship between either type of intervention and pregnancy intention.

8.1.19 Univariate linear regression

Univariate linear regressions with robust standard errors were done for all the significant variables and are shown in Table 8-5.

Univariate linear regression with robust standard errors		
Variable	**β coeff.** [xxiv]	**95%CI**
Socio-economic status	**Poorest 20% as baseline**	
Second-poorest 20%	0.35	-0.03, 0.74
Middle 20%	0.47	0.10, 0.85
Next-richest 20%	0.74	0.35, 1.12
Richest 20%	0.83	0.44, 1.22
Mother's age (years)	**18-29 as baseline**	
- 15-17	-1.02	-1.47, -0.56
- ≥ 30	-1.31	-1.59, -1.03
Father's age (years)	**20-29 as baseline**	
- 15-19	-2.02	-2.70, -1.35
- ≥ 30	-0.98	-1.23, -0.73
Mother's education level (yrs)	0.15	0.11, 0.18
Father's education level (yrs)	0.07	0.03, 0.10
Unmarried	-3.41	-3.78, -3.04
Number of live children	-0.53	-0.59, -0.47
Primigravida	1.43	1.17, 1.69
Birth interval	**< 2 years as baseline**	
- 2-3yrs	1.44	1.09, 1.78
- 3-4yrs	2.04	1.63, 2.45
- 4-5yrs	2.70	2.21, 3.19
- > 5yrs	2.53	2.03, 3.03
Gestation	-0.10	-0.18, -0.02
Previous depression	**None as baseline**	
- one/two for < 2 weeks	-0.95	-1.28, -0.61
- one for ≥ 2 weeks	-1.93	-2.29, -1.57
- both for ≥ 2 weeks	-2.23	-3.29, -1.18
Tribe	**Chewa as baseline**	
- Ngoni	-0.34	-0.84, 0.15
- Senga	1.35	0.80, 1.90
- Yao	0.26	-0.55, 1.06
- Other	0.63	-0.37, 1.63
Ever abused	-1.04	-1.34, -0.74
Abused in last year	-1.62	-2.07, -1.16
Abused while pregnant	-1.21	-1.84, -0.58
Sexual abuse	-1.61	-2.54, -0.68

Table 8-5 Univariate linear regressions of factors associated with pregnancy intention

[xxiv] The β coefficient (abbreviated to 'β coeff.' in the tables) represents the difference in the predicted value of LMUP score for each one-unit difference in that variable.

8.2 Univariate analysis discussion

Most of the findings of the univariate analyses confirmed the *a priori* hypotheses, as shown in Table 8-6, and are consistent with the published literature described in section 3.3.4. The relationship shown between the LMUP score and the number of live children in Figure 8-5 is particularly striking. Most studies on the determinants of pregnancy intention have looked at parity rather than number of live children. I chose to look at the number of live children as I felt that this was more relevant to pregnancy intention than parity in the context of high child mortality. Other studies have found that having four or more live children is associated with unplanned pregnancies (241, 251) but to my knowledge these are the first data showing that every additional child is associated with lower pregnancy intention.

Maternal education has long been recognised to be an important determinant of both maternal and child health (96, 344-346). In these data the relationship between maternal education and pregnancy intention is more obvious between zero and five years of education as the median LMUP score rises sharply from 5.5 to nine (see Figure 8-2). The median LMUP score remains at nine from five to nine years of education before increasing again at ten years of education to ten. In Malawi the first eight years of education are classed as primary education and the last four as secondary so it seems that the first five years of education give the biggest pay-off in terms of women being less likely to have an unplanned pregnancy. Getting girls into secondary education for at least one year yields an additional effect in reducing unplanned pregnancies, according to the univariate analysis.

Variable	Hypothesis	Univariate analysis
Socio-economic status	Increasing SES associated with higher pregnancy intention	Confirmed
Mother's age	Women below 18 and over 30 years have lower pregnancy intention	Confirmed
Father's age	Partner's aged below 20 and over 30 years associated with lower pregnancy intention	Confirmed
Mother's education level	Increasing education associated with higher pregnancy intention	Confirmed
Father's education level	Increasing education associated with higher pregnancy intention	Confirmed
Marital status	Married women have higher pregnancy intention	Confirmed
Number of live children	Increasing number of live children associated with lower pregnancy intention	Confirmed
Primigravida	Women having their first child have higher pregnancy intention	Confirmed
Birth interval	Short (< 24 months) and long (> 5 years birth intervals associated with lower pregnancy intention	Not confirmed – increase with time since last birth
Gestation	Increase in reported intention over time	Not confirmed – decrease
Previous depression	Increasing level of previous depression associated with lower pregnancy intention	Confirmed
Distance to health facility	Increasing distance to nearest health facility associated with lower pregnancy intention	Not confirmed – no relationship
Religion	No particular relationship expected	Consistent – no relationship seen
Tribe	No particular relationship expected	Not confirmed – relationship seen
Intimate partner violence	Experience of abuse associated with lower pregnancy intention	Confirmed
Support	Support associated with higher pregnancy intention	Not confirmed
Control	Control associated with higher pregnancy intention	Not confirmed
Food insecurity	Greater food security associated with higher pregnancy intention	Not confirmed
Women's groups / infant feeding counsellors	Prevalence expected to be too low to be of impact but potentially women who attended women's groups expected to have higher intention	Not confirmed

Table 8-6 Table showing the findings of the univariate analyses of factors associated with pregnancy intention

There were eight instances where the hypotheses were not confirmed and these are worthy of discussion. The first hypothesis that was not supported by the data was that there would be a U-shaped relationship between LMUP score and birth interval such that pregnancy intention would be lower in women with either less than 24 months or more than five years since last their birth. The data showed that as the birth interval increased so did the median LMUP score and this relationship was statistically significant. As noted in section 3.3.4, the data on the relationship between birth interval and pregnancy intention are sparse, only suggesting that short birth intervals are associated with unintended pregnancies and not saying anything about longer birth intervals. I hypothesised a U-shaped relationship as I thought that pregnancies occurring after five years would be unwanted pregnancies. However, the gradually increasing relationship that was seen is in keeping with what men and women said in the focus group discussions about ideal birth spacing, with participants tending to want three to five years between births (see section 11.3.1.2). Together these data would suggest that, in this setting, births occurring at least three years since the last birth will be more intended than those born within three years of the preceding birth.

The second hypothesis that was not supported by the data was that women who live further away from a health facility would have less intended pregnancies. There are several possible reasons for the lack of relationship seen. Firstly, the distance to the nearest health facility was calculated 'as the crow flies' from the location of the antenatal interview and takes no account of obstacles such as hills or rivers. The lack of a formal road network, or GPS data on the informal routes between communities and health centres, means that it was not possible to calculate the exact distance a woman would have to travel. Secondly, women may have been able to access family planning from outreach services, their local health surveillance assistant or from private pharmacies, meaning that the distance to the health facility is not a perfect proxy for the distance to access family planning. Finally, it may be that distance does not have an effect on contraceptive use, as others have found in Malawi (347).

Gestation is of interest as it is a marker of the time since conception i.e. the time since the period of interest for the LMUP, which is asking about thoughts, feelings and actions *before* becoming pregnant. There is some evidence that reported intention may change during the course of the pregnancy and that pregnancies are reported as more intended as time passes after birth, as discussed in section 2.3.1. For example, Poole et al. found a small decrease in the proportion of women reporting their pregnancies as unintended (on NSFG-style questions in the USA) when asked in the third trimester compared to the second trimester (106). The generalizability of these findings may be limited, as the population was a selected group of high-risk, multiparous women. However, on the basis of this literature I hypothesised that there may be a small difference in the LMUP scores of those women who were interviewed later in their pregnancy as compared to those women who were interviewed earlier, with those interviewed later having higher LMUP scores.

The univariate analysis found that women interviewed later in pregnancy had lower LMUP scores. This was the third hypothesis that was not supported by the data. It may be that the reported intentions of women later in their pregnancy are influenced by concerns about the approaching birth. Alternatively it may be due to confounding by other factors, such as maternal age, marital status and education, if the women who were visited later in pregnancy were different from those visited earlier.

The fourth finding that was contrary to expectations was the detection of a relationship between tribe and pregnancy intention. Discussion with local colleagues cannot discern any reason for this. For example, women from the Senga tribe, who had higher LMUP scores, are not known to be a particularly wealthier or more educated group. It may be that, in these data, tribe is associated with differences in SES, education levels, maternal factors or a combination of these factors and that this is what accounts for the observed differences.

The fifth hypothesis that was not supported by the data was that food insecurity would be associated with less planned pregnancies. There are no

published data on the relationship between pregnancy intention and food security and it may be that there is no relationship. Food security was included as a relationship was observed between food security and maternal mental health status in another area of Malawi (Dr Stewart, personal communication) and it could therefore be a potential confounder. It was a late addition to the questionnaire so the lack of relationship could be because of the level of missing data for this variable and a consequent loss of power. Alternatively, it may be due to measurement error as I measured food security using a single question whereas it is a multi-dimensional concept. The Household Food Insecurity Access Scale (HFIAS) (348) has now been translated into Chichewa and is being used by another group (Dr Phiri, personal communication). This would be preferable for any future data collection.

Measurement error is also a possible explanation for the lack of an observed relationship between the variables of support and control, the sixth and seventh hypothesis that were not supported by the data. These were each assessed by a single question but again they are both more complex than this. There is a Multidimensional Scale of Perceived Social Support (349) which is currently being tested in Malawi and which could be a better measure for use in the future.

Finally, the lack of relationship between women's group attendance and pregnancy intention is not surprising given the fact that very few women in this research had ever received these interventions. This is because this research covered control areas as well as intervention areas in addition to the fact that the trial had finished almost four years ago. Furthermore, the focus of these groups was not on family planning.

8.3 Multivariate analysis results

As described in section 5.4.3.1, I selected a linear regression with robust standard errors for the multivariate regression.

8.3.1 Stepwise selection

Using all variables assessed in the univariate analysis both forward and backward stepwise linear regressions selected: mother's age, previous depression, asset index, marital status, number of living children, birth interval and abuse in the last year for the model (data not shown). The likelihood ratio test confirmed that the selected models were better than the model with all the variables included.

8.3.2 Hierarchical multivariate analysis

I created a hierarchical model, using the conceptual framework (Figure 5-2) to determine the factors at each level and following the steps explained in section 5.4.3.4, to explore the determinants of pregnancy intention. Only variables with a p-value of <0.10 on univariate analysis were considered for the hierarchical analysis. This meant that religion, distance to health facility, support, control, food security, women's group attendance and visits from infant feeding counsellors were excluded from the start. Model 1 considered only socio-economic status (SES) at Level 1 and showed a significant effect of SES on pregnancy intention with pregnancy intention increasing with increasing SES.

	Model 1			
	β coeff.	**95%CI**		**p-value**
Socio-economic status	Poorest 20% baseline			
- second-poorest 20%	0.35	-0.03	0.74	0.002
- middle 20%	0.47	0.10	0.85	
- next-richest 20%	0.74	0.35	1.12	
- richest 20%	0.83	0.44	1.22	
constant	6.39			

Determinants Model 1 Socio-economic status and pregnancy intention

SES was retained and socio-demographic factors, including geographical cluster as a random effect, were added at Level 2 to create Model 2. SES became non-significant in this model (p=0.72); the correct interpretation of this is not that SES is not related to intention but that the effect of SES is mediated through these socio-demographic factors. In Model 2 the socio-

demographic factors that were significant at p<0.10 were mother's education level, father's age and marital status. Their β coefficients show their effect adjusted for the confounding effect of SES but not adjusted for mediating factors lower down the hierarchy.

	Model 2			
	β coeff.	**95%CI**		**p-value**
Socio-economic status	**Poorest 20% baseline**			
- second-poorest 20%	-0.18	-0.63	0.27	0.72
- middle 20%	-0.21	-0.63	0.20	
- next-richest 20%	-0.03	-0.46	0.41	
- richest 20%	-0.11	-0.59	0.38	
Mother's education level (yrs)	0.10	0.07	0.14	<0.001
Father's age (yrs)	**20-29 as baseline**			
- 15-19	-1.06	-1.67	-0.45	<0.001
- ≥ 30	-0.94	-1.26	-0.63	
Unmarried	-3.45	-4.10	-2.80	<0.001
constant	7.27	6.66	7.87	<0.001
sigma_u	0.76			
sigma_e	3.73			
rho	0.04			

Determinants Model 2 SES, socio-demographic factors and pregnancy intention

Rho did not equal zero,[xxv] indicating that there was between-cluster variability i.e. an effect of cluster beyond that due to the variation in SES between clusters. Cluster was therefore retained in the model as a random effect. Tribe (p=0.81) and father's education (p=0.20) were not significant. Removing tribe from the model made no significant difference to the fit of the model. This suggests that the univariate finding of an association between tribe and pregnancy intention was confounded by other factors. Father's education remained insignificant without tribe in the model so was also removed. The model without tribe and father's education was not a poorer fit than the model with them (p=0.66).

[xxv] Rho is the intra-class correlation coefficient, which is the ratio of the between-cluster variance ((sigma_u)^2) to the total variance ((sigma_u)^2 plus the within-cluster variance, (sigma_e)^2). Rho measures the amount of variation that is explained by differences between clusters; if rho=0 there is no evidence of clustering.

Model 2 tells us that, having controlled for SES, each additional year of mother's education is associated with a 0.10 point increase in LMUP score (95%CI 0.07, 0.14). Additionally, fathers aged under 19 or over 29 are associated with about a one point reduction in LMUP score and unmarried women have an LMUP score that is 3.45 points lower (95%CI -4.10, -2.80) than married women.

The variables added into Model 3 were previous experience of depression and the four questions about intimate partner violence (IPV) that had been significant on univariate analysis. Any possible experience of previous depression was strongly associated with lower pregnancy intention, having controlled for the confounding effects of SES and socio-demographic factors. Two of the four IPV variables were associated with lower pregnancy intention: abuse in the last year and having been forced to do something sexual. The other two IPV variables were removed from the model sequentially. All the socio-demographic factors from Level 2 were still statistically significant; these coefficients show their effect that is not mediated through previous experience of depression or IPV. SES remained not significant overall.

Having experienced a possible episode of depression that lasted less than two weeks was associated with a 1.08 reduction in LMUP score (95%CI -1.49, -0.66) whereas if the episode lasted more than two weeks the corresponding reduction in LMUP score was around two points. Experiencing either sexual abuse or physical abuse in the last year were each associated with about a one-point decrease in LMUP score.

	Model 3			
	β coeff.	**95%CI**		**p-value**
Socio-economic status	**Poorest 20% baseline**			
- second-poorest 20%	-0.16	-0.64	0.31	0.77
- middle 20%	-0.22	-0.63	0.19	
- next-richest 20%	-0.05	-0.52	0.42	
- richest 20%	-0.06	-0.56	0.44	
Mother's education level (yrs)	0.11	0.07	0.14	<0.001
Father's age (yrs)	**20-29 as baseline**			
- 15-19	-1.15	-1.75	-0.56	<0.001
- ≥ 30	-0.90	-1.19	-0.62	
Unmarried	-3.27	-3.96	-2.58	<0.001
Previous depression	**Never as baseline**			
- one/two < 2 weeks	-1.08	-1.49	-0.66	
- one ≥ 2 weeks	-1.70	-2.43	-0.96	<0.001
- both ≥ 2 weeks	-2.07	-3.01	-1.14	
IPV - in last year	-1.03	-1.47	-0.58	<0.001
IPV - sexual abuse	-0.86	-1.53	-0.18	0.01
constant	7.67	7.08	8.26	<0.001
sigma_u	0.70			
sigma_e	3.66			
rho	0.04			

Determinants Model 3 SES, socio-demographic factors, previous depression, IPV and pregnancy intention

Maternal reproductive factors were added to create Model 4. All three variables; mother's age, number of live children and primiparity / birth interval, were statistically significantly associated with pregnancy intention having adjusted for SES, socio-demographic variables, previous depression and IPV. Women aged under 18 were more likely to report their pregnancy as unintended whereas women over 29 displayed a small increase in intention as compared to women aged 18-29. Each additional child was associated with a reduction in LMUP score of 0.74 points and women who had given birth within the last three years reported their pregnancies as more unintended than those who were either having their first child or had given birth more than three years ago. All these factors were retained in the model.

Previous depression and abuse in the last year had significant residual effects i.e. an effect not mediated through maternal reproductive

characteristics. Marital status and father's age also showed a significant effect that was not mediated through previous depression, abuse in the last year and maternal reproductive characteristics. Conversely, the effects of mother's education and having been forced to do something sexual seem to be mediated through maternal reproductive factors. The effect of SES remains mediated through the factors below it in the hierarchy.

	β coeff.	Model 4 95%CI		p-value
Socio-economic status	**Poorest 20% baseline**			
- second-poorest 20%	-0.16	-0.62	0.30	0.26
- middle 20%	-0.20	-0.58	0.17	
- next-richest 20%	0.12	-0.38	0.61	
- richest 20%	0.04	-0.46	0.54	
Mother's education level (yrs)	-0.03	-0.06	0.01	0.12
Father's age (yrs)	**20-29 as baseline**			
- 15-19	-1.40	-1.98	-0.82	<0.001
- ≥ 30	0.38	0.10	0.66	
Unmarried	-3.62	-4.24	-3.00	<0.001
Previous depression	**Never as baseline**			
- one/two < 2 weeks	-0.90	-1.31	-0.49	<0.001
- one ≥ 2 weeks	-1.34	-1.97	-0.70	
- both ≥ 2 weeks	-1.50	-2.43	-0.56	
IPV - in last year	-0.83	-1.27	-0.39	<0.001
IPV - sexual abuse	-0.51	-1.18	0.15	0.13
Mother's age (years)	**18-29 as baseline**			
- 15-17	-1.09	-1.48	-0.70	<0.001
- ≥ 30	0.37	-0.01	0.74	
Number of live children	-0.74	-0.87	-0.61	<0.001
Birth interval	**First birth as baseline**			
< 24 months	-1.85	-2.21	-1.49	<0.001
- 2-3 years	-0.59	-1.08	-0.11	
≥ 3 years	0.49	0.07	0.92	
constant	9.54	8.94	10.14	<0.001
sigma_u	0.51			
sigma_e	3.44			
rho	0.02			

Determinants Model 4 SES, socio-demographic factors, previous depression, IPV, maternal reproductive factors and pregnancy intention

Finally, gestation was added to the analysis to create Model 5 (not shown). Having controlled for the other factors in the model, gestation did not have a

statistically significant effect on pregnancy intention (p=0.45). This suggests that the univariate finding was confounded by other factors. All other factors that were significant in Model 4 remained significant and there was little change in the estimates of the coefficients. Gestation was excluded from the model and Model 4 was accepted as the final model.

Table 8-7 shows the effect size estimate for each variable at the level it entered the model. These are the direct effects of those factors on pregnancy intention, adjusted for the factors above them in hierarchy.

	Direct effects Model			
	β coeff.	**95%CI**		**p-value**
Socio-economic status	**Poorest 20% baseline**			
- second-poorest 20%	0.35	-0.03	0.74	
- middle 20%	0.47	0.10	0.85	0.002
- next-richest 20%	0.74	0.35	1.12	
- richest 20%	0.83	0.44	1.22	
Mother's education level (yrs)	0.10	0.07	0.14	<0.001
Father's age (years)	**20-29 as baseline**			
- 15-19	-1.06	-1.67	-0.45	<0.001
- ≥ 30	-0.94	-1.26	-0.63	
Unmarried	-3.45	-4.10	-2.80	<0.001
Previous depression	**Never as baseline**			
- one/two < 2 weeks	-1.08	-1.49	-0.66	
- one ≥ 2 weeks	-1.70	-2.43	-0.96	<0.001
- both ≥ 2 weeks	-2.07	-3.01	-1.14	
IPV - in last year	-1.03	-1.47	-0.58	<0.001
IPV - sexual abuse	-0.86	-1.53	-0.18	0.01
Mother's age (years)	**18-29 as baseline**			
- 15-17	-1.09	-1.48	-0.70	<0.001
- ≥ 30	0.37	-0.01	0.74	
Number of live children	-0.74	-0.87	-0.61	<0.001
Birth interval	**First birth as baseline**			
< 24 months	-1.85	-2.21	-1.49	
- 2-3 years	-0.59	-1.08	-0.11	<0.001
≥ 3 years	0.49	0.07	0.92	

Table 8-7 Direct effect of each variable on pregnancy intention having controlled for variables higher in the hierarchy

8.3.3 Sensitivity analyses

8.3.3.1 Comparison of linear regression with partial proportional odds ordinal logistic regression

I compared the findings of the hierarchical linear regression with those of a partial proportional odds ordinal logistic regression with LMUP scores in three groups (0-3, 4-9 and 10-12). The findings were the same as the linear regression at each level and all estimates of effect were in the same direction. The same variables were selected for the final model with the exception of gestation, which was significant in the partial proportional odds ordinal logistic regression at the $p<0.10$ cut-off ($p=0.087$). As in the linear regression, maternal education was significant in levels two and three but became non-significant once level four variables were added. The fact that the models are so similar provides reassurance that, despite the violation of the assumptions of the linear regression (described in Appendix W), the linear regression with robust standard errors is a suitable representation of the data.

8.3.3.2 Reversal of Levels three and four of the conceptual hierarchy

Conceptually it could be argued that maternal reproductive factors could come before previous depression and IPV in the hierarchy. For example, having a high number of children could have been a contributing factor to the previous depression. However, it is equally the case that previous depression could have led to the high number of children as we saw in section 3.3.3.5 that unintended pregnancies are more common in women with depression (228). In recognition of the fact that we are looking at experience of depression or abuse in the last year whereas the maternal reproductive factors are measures of current status, I decided to put previous depression and IPV above maternal reproductive factors in the hierarchy. Running the model with maternal reproductive factors entered before previous depression and IPV made no difference to the selection of variables at levels three and four or to the final model.

8.3.3.3 Non-imputed LMUP data

Running the model with only women who answered all six LMUP questions, and therefore had not had their LMUP score imputed, made no difference to the selection of variables at any level or to the final model. Given the small amount of missing LMUP data this was not surprising.

8.3.3.4 Comparison of stepwise regressions with hierarchical regression

The hierarchical regression retained three variables that were excluded in the stepwise regressions: mother's education, father's age and sexual abuse. Mother's education and sexual abuse had become non-significant by the end of the hierarchical analysis but father's age was still significant.

8.4 Hierarchical multivariate analysis discussion

The interpretation of the final hierarchical linear regression model (Model 4) is that, while increasing SES is associated with increasing pregnancy intention, the effect of SES is mediated through socio-demographic variables, previous experience of depression, IPV and maternal reproductive factors. The socio-demographic factors of importance are marital status, partner's age and mother's education level. However, the effect of mother's education level appears to be mediated by maternal reproductive characteristics. Previous experience of depression is associated with lower pregnancy intention, even having controlled for SES and socio-demographic factors and independent of the effect that it has that is mediated through maternal reproductive factors. The same is true of having experienced abuse in the last year but not of having experienced sexual abuse, whose effect is mediated through maternal reproductive factors. Mother's age, number of live children and primiparity / birth interval are all associated with pregnancy intention having controlled for SES, socio-demographic factors, previous depression and IPV. Having controlled for these factors there is no effect of gestational age on reported pregnancy intention.

Tribe and gestation, the puzzling univariate findings, were not included in the final model suggesting that there was some confounding of these factors that explained the univariate relationship. The lack of a difference in reported

intention between months two and nine of pregnancy at a population level is an important finding. This means that using the LMUP during pregnancy should yield a valid assessment of pregnancy intention, regardless of when it is asked. Given that Yeatman et al. showed that there was good agreement between the last prospective measurement taken before conception and the first retrospective measure during pregnancy (109), using the LMUP during pregnancy may even be a reasonable proxy for pre-conception intention, negating the need to assess prospective intentions where the aim is to assess the prevalence of unintended pregnancy. However, as women were only asked the LMUP once during pregnancy we cannot rule out changes at an individual level that may have been masked at a population level, as found by Poole et al. (106). Further research would be needed to assess the stability of the LMUP on an individual level during pregnancy.

The relationship with maternal age changed from a U-shaped relationship on the univariate analysis to a linear relationship in the multivariate analysis. In the univariate analysis women aged 18-29 had higher LMUP scores than either younger or older women. However, in the multivariate analysis women over 30 had higher LMUP scores than women aged 18-29 who in turn had higher LMUP scores than women aged 15-17. The same change, from a U-shaped relationship on the univariate analysis to a linear relationship in the multivariate analysis, was seen for partner's age.

The relationships between pregnancy intention and age, marital status and parity found in this analysis are in keeping with the findings of other studies (247, 248, 253, 255). Having used a hierarchical approach to the analysis, these results are able to shed some light on the inconsistent findings of other studies with regard to SES and maternal education. Had I not followed a hierarchical approach, SES would not have been statistically significant and we would have concluded, like Ikamari et al. (248) and Melian (253) that there was no relationship between SES and pregnancy intention. The same applies to maternal education, where our negative findings would have agreed with Ikamari et al. (248). However, in my univariate analysis women with high levels of education reported their pregnancies as more planned and

in the multivariate analysis the level of maternal education was significant in Model 2 and Model 3. It was only once women's age and reproductive factors (birth interval and number of live children) were included in the model that maternal education was no longer statistically significant. This means that the effect of maternal education is mediated through these factors, not that it is not important. The same is true for SES; its effect is mediated through its influence on other factors. The differences between study findings noted in section 3.3.4.1 may therefore be due to the methodology of the analysis and/or whether or not the factors through which maternal education or SES affect pregnancy intention have been included.

Using the whole of the LMUP score in the analysis enables us to see the effect of each determinant on the score, rather than on the odds of having an unintended pregnancy. This is a unique benefit of having used the LMUP and has not been done before; even where the LMUP has been used pregnancies have been categorised as intended or unintended and logistic regressions performed (63, 239, 256). The most important determinant of pregnancy intention was marital status, with unmarried women having an LMUP score that is 3.45 points lower (95%CI -4.10, -2.80) than married women. Any previous episode of depression lasting more than two weeks was the next most important factor at -2.07 points (95%CI -3.01, -1.14), followed by a birth interval of less than 24 months (-1.85 95%CI -2.21, -1.49). The strong relationship seen on the univariate analysis between the number of live children and pregnancy intention remained in the multivariate analysis. Each additional child was associated with a 0.74-point reduction in the LMUP score (95%CI -0.87, -0.61). The high number of children that women in Mchinji District tend to have makes this an important determinant.

8.5 Women at risk of an unplanned pregnancy

While any woman can experience an unplanned pregnancy, inspection of the risk factors identified and consideration as to how these risks cluster led the to identification of three groups of women in Mchinji District who are at higher risk of unintended pregnancies. These were younger, unmarried women having their first pregnancy; older married women who have recently given

birth and/or who already have as many children as they want; and women of any age, marital status or parity who have experienced depression, abuse in the last year or sexual abuse. The first two groups are mutually exclusive, however, the third group may overlap with either of the first two. Overall 38.6% of women fell into one or more of the high-risk groups. Of the women whose pregnancies were more unplanned (LMUP score ≤3 (32.6%, n=1319)), just over half (51.1%) were in one of the three high-risk groups. Conversely 44.4% of all women (n=1796) had a planned pregnancy (LMUP≥10) and of these, 72.4% (n=1300) were in the low-risk group. The different distributions of LMUP score for these three groups are shown in Figure 8-9, Figure 8-10 and Figure 8-11. The distributions are clearly markedly different to that of the general population shown in Figure 7-3 ($p<0.001$ on Wilcoxon rank sum test for women in each of the at-risk groups compared to women who are in none of the groups). The implications of these findings are discussed in Chapter 12.

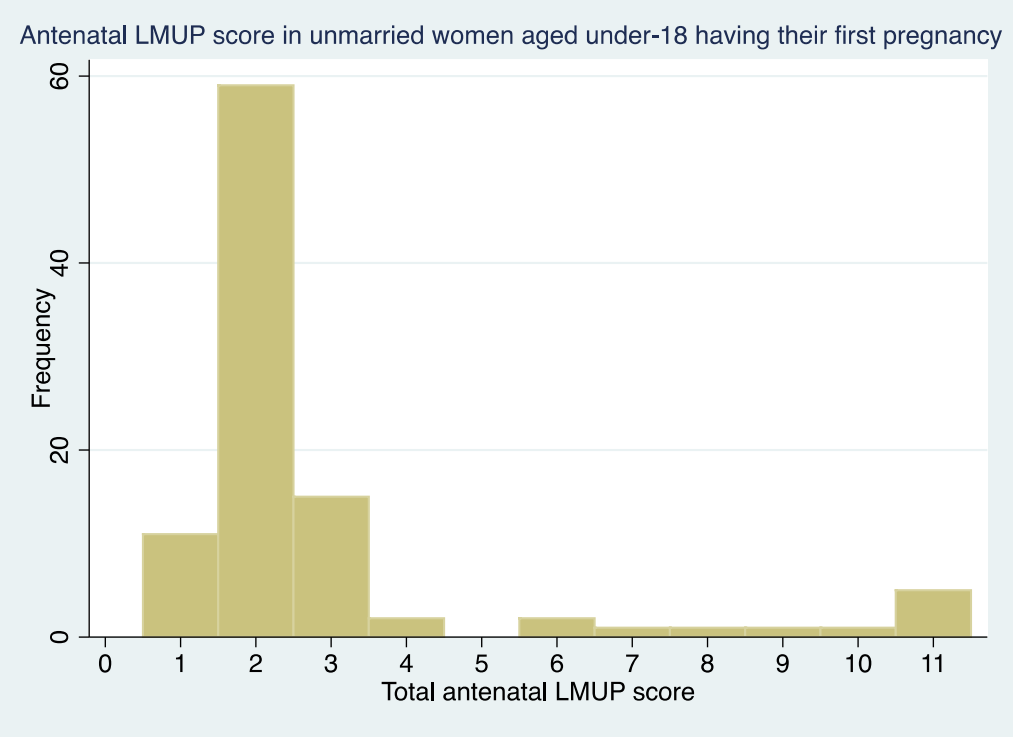


Figure 8-9 LMUP score distribution in unmarried women aged under 18 having their first pregnancy

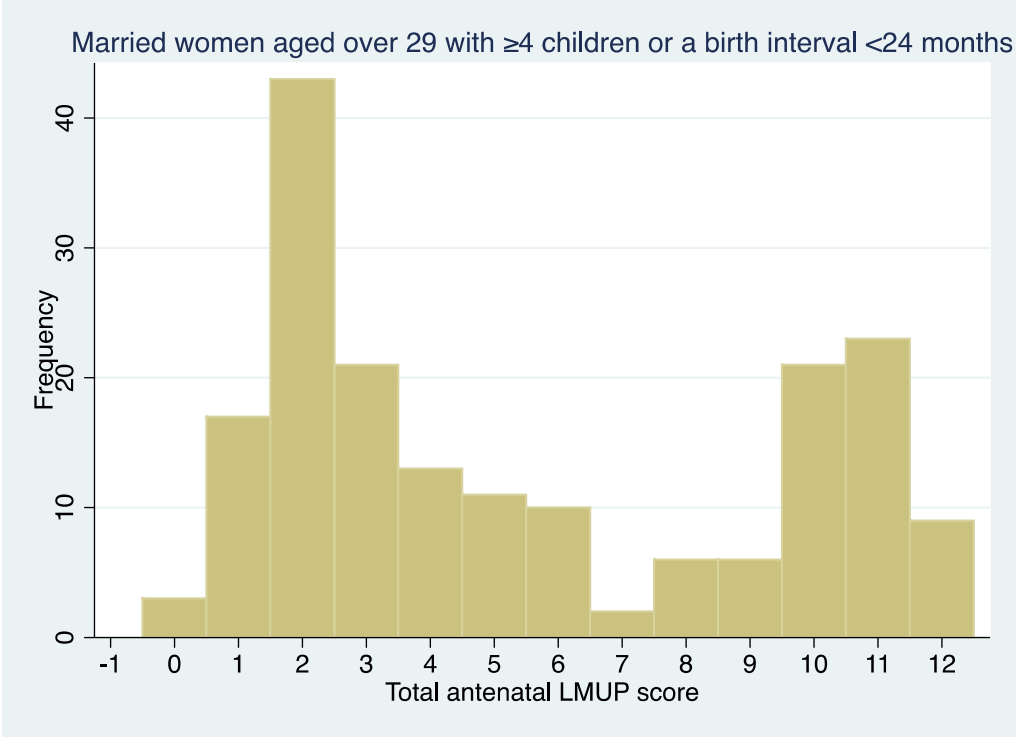


Figure 8-10 LMUP score distribution in married women aged over-29 with at least four children or a birth interval of less than 24 months

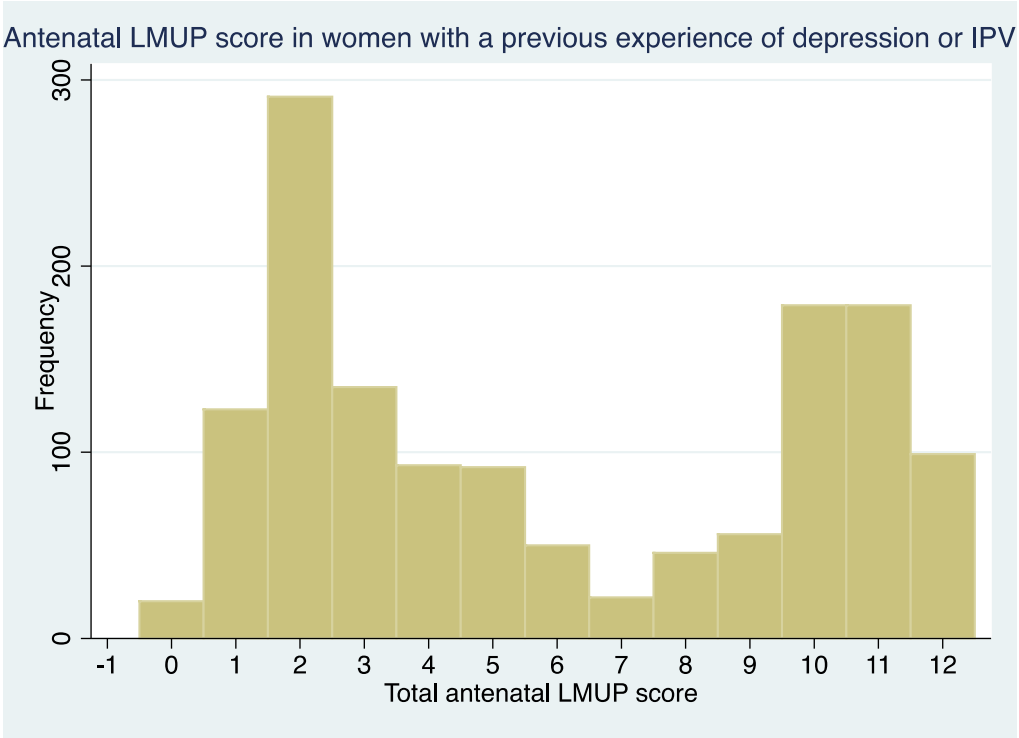


Figure 8-11 LMUP score distribution by possible episodes of previous depression

8.6 Chapter summary

In this Chapter we have seen which factors are associated with pregnancy intention, as reported antenatally using the LMUP, in pregnant women in Mchinji District. A hierarchical multivariate linear regression model has helped to explore the ways in which these variables affect pregnancy intention and identify which women are at risk of an unintended pregnancy. The next Chapter will describe the follow-up of the cohort, the data collected postnatally on behaviours and outcomes and the univariate relationships between pregnancy intention and these behaviours.

Chapter 9 Descriptive analyses of the postnatal data

In this Chapter I describe the data collected at the postnatal interview. The case flow and loss to follow-up is outlined and I compare the women who were lost with those who were not to check for selection bias. The prevalence of the maternal and neonatal pregnancy outcomes of interest is described. There are separate sections for antenatal (section 9.5), delivery (section 9.6) and postnatal factors (section 9.7) where the data collected in the postnatal interviews about behaviours and problems during these time-periods are described and their associations with pregnancy intention (antenatal LMUP score) are assessed. At the end of each of these sections the associations between the factors in that section and the outcome relevant to that section are presented. For example, at the end of the antenatal section the relationships of the antenatal factors with miscarriage are presented. This is so that in each section we can see how pregnancy intention is related to behaviours and how these behaviours are then related to the outcomes of interest. The next Chapter will take these relationships forward in hierarchical multivariate analyses of the relationships between pregnancy intention and maternal and neonatal outcomes.

All these analyses are conducted using imputed values for missing data in the antenatal LMUP, the antenatal and postnatal SRQ and birthweight as described in section 5.2.

9.1 Follow-up and selection bias

Of the 4,244 women who had an antenatal interview 3,986 also had a postnatal interview, as shown in Figure 9-1. This was a loss to follow-up of 258 women or 6.08%. Migration was the most common reason why women were lost to follow-up, at 5.44%. Only 27 women did not consent to the postnatal interview (0.64%). In total there were 10 maternal deaths; in eight of these cases an abbreviated postnatal interview via proxy was possible, while in two cases no was proxy available so only the outcome of maternal

death is known. This means that for most maternal variables the maximum number of values is 3,984.

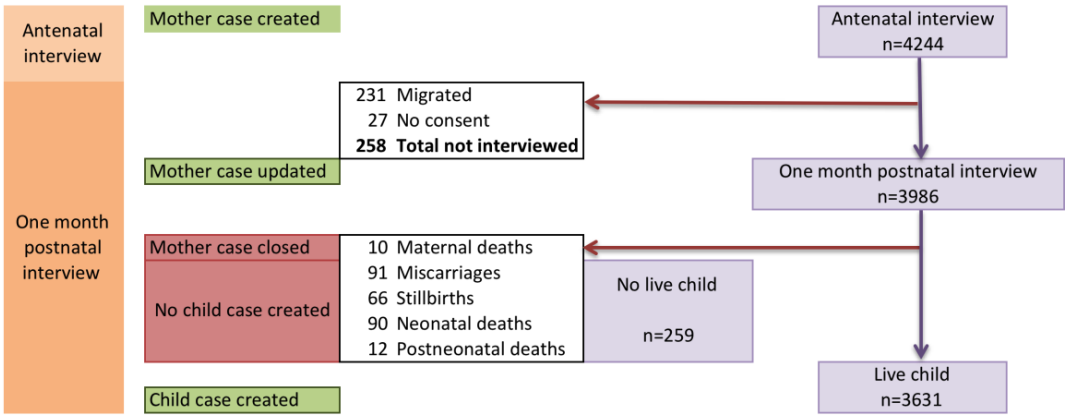


Figure 9-1 Case flow from antenatal interview to postnatal outcome

In cohort studies loss to follow-up is a common problem due to the challenges of trying to follow individuals over an extended period of time. It can be a significant problem, both in terms of loss of power due to reduced sample size and because of the potential for selection bias to be introduced into the sample. I compared the 258 women who were lost to follow-up with the remaining 3,986 women using two-sided t-tests for age, socio-economic status (SES), parity and birth interval, two-sided chi-squared tests for marital status and education and the Kruskal-Wallis one-way analysis of variance for antenatal LMUP score. There were no statistically significant differences seen on LMUP score, marital status, education, SES or birth interval. On average the women who were lost to follow-up were slightly younger (mean 24.0 versus 25.1, $p<0.01$) and had had fewer previous pregnancies (1.76 versus 2.21, $p=0.0014$). Given the strong correlation between increasing age and increasing number of previous pregnancies, parity was stratified by age group and the differences in parity became non-significant i.e. were explained by the differences in age.

The relatively small loss to follow-up and the general lack of statistically significant differences, with the exception of age, suggests that there is not a significant risk of the introduction of selection bias and that the postnatal

sample remains representative of the population of pregnant women in Mchinji District.

9.2 Timing of the interviews

As described in section 4.5, postnatal interviews were scheduled using the estimated delivery date plus 35 days. The median time since delivery (live or stillbirth) at postnatal interview was 40 days (IQR 27 to 79 days).

9.3 Outcomes

9.3.1 Miscarriage, multiple births, stillbirths and live births

Figure 9-2 shows the miscarriages, multiple births, stillbirths and live births resulting from the 3,984 pregnancies for which we have outcome data. For this research, miscarriages were defined as pregnancy losses occurring before seven completed months and stillbirths as those occurring after seven completed months (see Box 1-1). There were 91 miscarriages (2.28% of pregnancies), leaving 3,893 pregnancies from which a total of 3,957 babies were born. Of these 3,957, 66 (1.67%) were stillbirths, a rate of 16.7 per 1000 births (95%CI 12.9, 21.2), and 3,891 were live births.

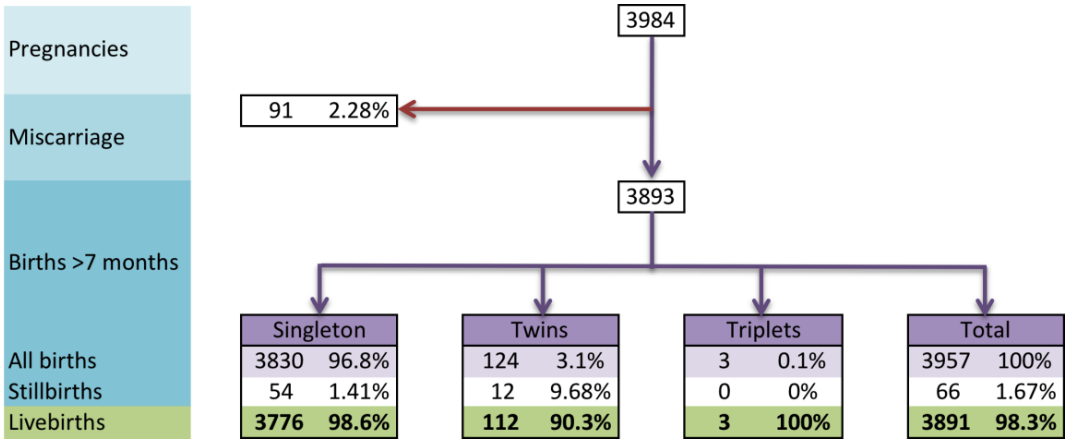


Figure 9-2 Flow chart of the outcome of pregnancies

Of the 3,957 babies born after seven completed months, 3,830 (96.8%) were singletons; there were 62 sets of twins (124 babies, 3.1% of babies) and one set of triplets (0.1% of babies). In terms of the pregnancies, 98.4% of women were carrying one baby (n=3,830) and 1.6% were carrying twins (n=62) or triplets (n=1). 52% of babies were male.

There were 54 stillbirths amongst the 3,830 singleton pregnancies, a rate of 14.1 per 1,000 births (95%CI 10.6, 18.4). The regional estimate for the rate of stillbirths in sub-Saharan Africa was considerably higher at 28.3 per 1,000 births in 2009 (17). There is very little data from Malawi with which to compare this. One hospital-based study in Blantyre found that 3.4% of women lost their pregnancy after 20 weeks (350). In my research stillbirth was defined as occurring after seven completed months (28 weeks) so this is not directly comparable. Combining the miscarriages in my data (most of which will have happened after 20 weeks given that women were interviewed at a median of 24 weeks) with the stillbirths gives a prevalence of 3.9% - similar to that seen in Blantyre.

It is important to note that, in the absence of any reliable method of assessing gestational age in Mchinji District, the categorisation of miscarriage or stillbirth is based on the mother's assessment of gestation and there is therefore considerable potential for misclassification. Furthermore, the miscarriage rate I observed is an underestimate of the total miscarriage rate as early miscarriages were not captured, recruiting, as I did, women whose pregnancies had already survived long enough for them to have been reported through the surveillance system.

9.3.2 Birthweight

Missing birthweight data were imputed as described in section 5.2.5 and Appendix U. The average birthweight was 3.16kg (standard deviation 0.616g). 13.3% of babies had a birthweight below 2.5kg, similar to UNICEF's estimated prevalence for Malawi of 14.0% for 2013 (351). Twins were more likely to be low birthweight than singletons (61.4% v 11.4%, $p<0.001$) and low birthweight was more common in female babies (15.3% v 10.8%, $p<0.001$).

9.3.3 Prematurity

Prematurity is another adverse pregnancy outcome that could be related to pregnancy intention. However, in the research setting there is no reliable way of assessing the gestation of the baby at any time point and consequently no way of accurately determining prematurity. Therefore, I did

not include prematurity as one of the key outcomes of interest. Women were, however, asked whether they thought that the birth was early, on time or late. From this 8.8% said that the birth was early and 10.1% that it was late.

9.3.4 Neonatal death

Out of the 3,891 live births there were 102 deaths by the time of the postnatal interview. The timing of these is shown in Table 9-1 with early neonatal deaths being deaths in the first week of life, late neonatal deaths being those in the second to fourth weeks of life and the post-neonatal deaths being those after four weeks of life. In total there were 90 early- or late-neonatal deaths (88.2% of all deaths) that are the outcomes of interest for this research. This gives an overall neonatal mortality rate (NMR) of 23.1 neonatal deaths per 1,000 live births (95%CI 18.6, 28.4). This is in keeping with UNICEF's estimated NMR of 23.0 for Malawi in 2013 (351).

When the baby died		
	Freq.	**Percent.**
Early neonatal	69	67.6
Late neonatal	21	20.6
Post neonatal	12	11.8
Total	**102**	**100**

Table 9-1 Timing of infant death

Eighty-three of the 90 neonatal deaths were in singleton births, an NMR of 22.0 (95%CI 17.5, 27.3). Neonatal deaths were more common in twins, with an NMR of 62.5 (95%CI 25.1, 128.8), though this difference was not statistically significant. Neonatal deaths were significantly more common in boys than girls (3.03% v 1.39%, p=0.001), as was found in the other study of stillbirth and early neonatal death in Malawi (350).

9.3.5 Maternal death

During the course of the follow-up, there were 10 maternal deaths in women who had been interviewed antenatally. From 3,891 live births this gives a maternal mortality ratio (MMR) of 257 per 100 000 live births (95%CI 123.2, 472.6). This is lower than the World Health Organization estimate for 2010

of 510 per 100,000 live births (95%CI 320, 830) (2), however these figures are compatible as the confidence intervals overlap. An MMR of 257 is consistent with previous estimates in Mchinji District of 328 in 2009 (327) and 300 in 2011-12 (352) (95%CI not given). There are reasons to believe that the MMR may be lower in Mchinji District than for Malawi as a whole. For example, the cluster randomised controlled trial of women's groups conducted in Mchinji District showed a 52% reduction in the MMR from 533 in 2004 to 328 in 2009 (327). Subsequently community maternal death reviews have been instigated which may have contributed to further reductions (352).

The timing of maternal death in relation to the birth was only known for eight of the 10 maternal deaths. Figure 9-3 shows that five of these (62.5%) occurred on the day of delivery and 87.5% occurred within the first month. Of the eight maternal deaths where an outcome was known for the baby, there were four babies that were born alive but only one was still alive at the time of the postnatal interview.

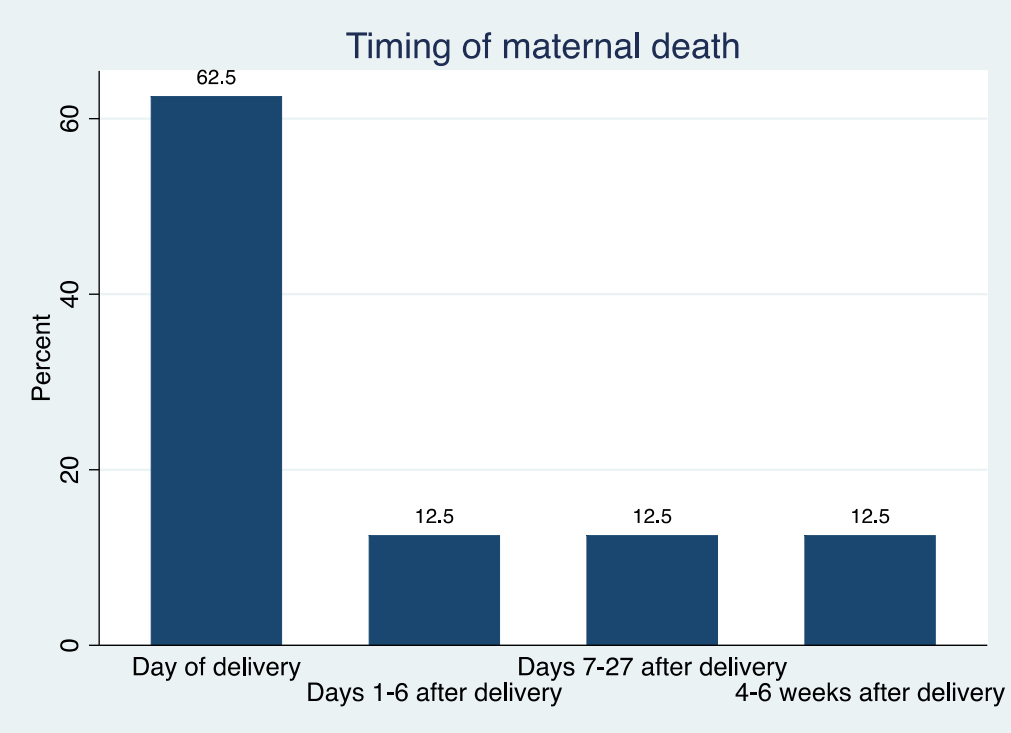


Figure 9-3 Bar-chart showing the timing of maternal death

9.3.6 Postnatal mental health status

Women were asked the World Health Organization's Self-Reporting Questionnaire (SRQ) again in the postnatal interview. Their responses to each question are shown in Table 9-2.

Postnatal responses to SRQ questions		
	No (%)	**Yes (%)**
Do you often have headaches?	71.5	28.5
Is your appetite poor?	85.6	14.4
Do you sleep badly?	85.2	14.8
Do your hands shake?	93.4	6.60
Do you feel nervous, tense or worried?	81.8	18.2
Are you easily frightened?	93.1	6.90
Is your digestion poor?	93.8	6.20
Do you have trouble thinking clearly?	91.2	8.80
Do you feel unhappy?	87.9	12.1
Do you cry more than usual?	96.0	4.00
Do you find it difficult to enjoy your daily activities?	89.3	10.7
Do you find it difficult to make decisions?	93.5	6.50
Is your daily work suffering?	87.6	12.4
Are you unable to play a useful part in life?	90.8	9.20
Have you lost interest in things?	89.0	11.0
Do you feel that you are a worthless person?	95.0	5.00
Has the thought of ending your life been on your mind?	98.4	1.60
Do you feel tired all the time?	87.8	12.2
Do you have uncomfortable feelings in your stomach?	70.9	29.1
Are you easily tired?	87.1	12.9

Table 9-2 Women's responses to the WHO SRQ postnatally

The distribution of scores is shown in Figure 9-4. Postnatally women's SRQ scores ranged from zero to eighteen (median one, IQR zero to three). 34.1% of women reported no symptoms and, using the cut point of 7/8 used by Stewart et al. (313), just 7.17% of women screened positive for minor or major depression. However, since this assessment mostly only covers the neonatal period and many postnatal mental health problems occur after this time this is likely to be an underestimate of the burden of postnatal mental health issues.

There are striking differences with the antenatal SRQ distribution when just 8.36% of women reported no symptoms and over 23% of women screened

positive for minor or major depression (section 7.7). This difference is statistically significant (p<0.001). This suggests that pregnancy is a time of greater anxiety and stress than the neonatal period for women in Mchinji District. Indeed women sometimes use the Chichewa word 'pakati' to refer to being pregnant, which translates as 'the place between life and death' (personal observation).

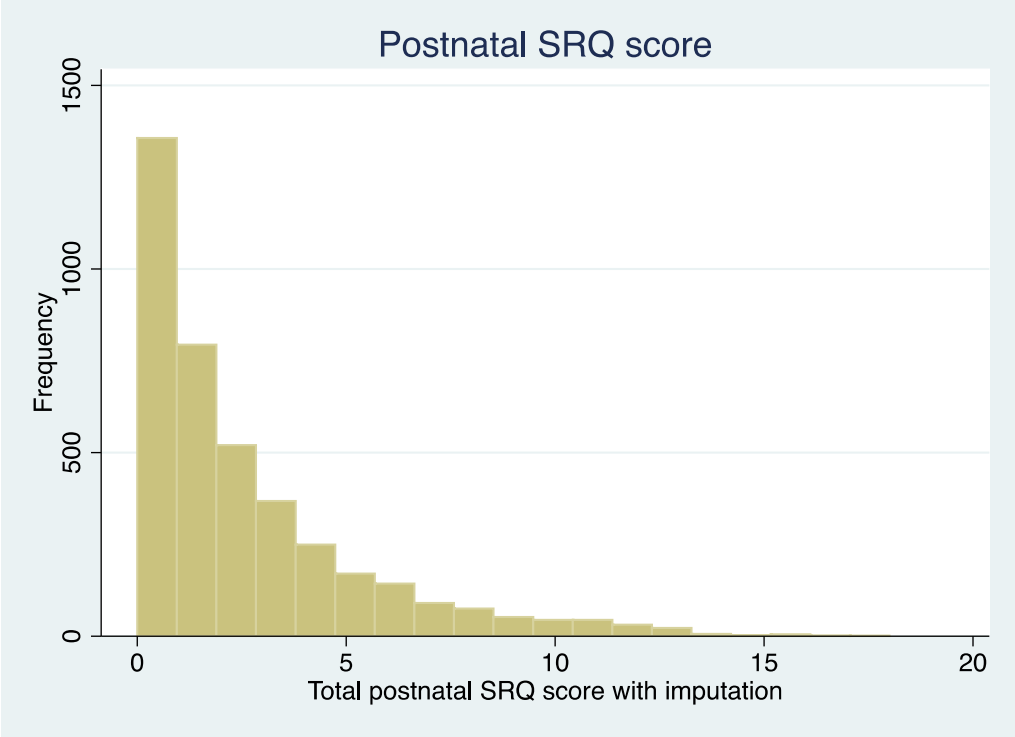


Figure 9-4 Distribution of women's postnatal SRQ scores

Women who had a multiple birth were more than twice as likely to screen positive for minor or major postnatal depression than women who had a single baby (OR 2.27, 95%CI 1.35, 3.79) but there was no difference in postnatal SRQ score by the gender of the child, supporting the perceived absence of a strong gender preference in Mchinji District.

9.3.6.1 Suicidality

Only 1.6% of postnatal women (n=65) said that the thought of ending their life had been on their mind. These women were asked additional questions about whether she had these thoughts all of the time, if she had thought of a way to commit suicide and whether she had actually tried to commit suicide.

Almost all (62 women, 95.4%) answered no to all of the additional suicide questions; two said yes to one (3.08%) and one said yes to two (1.54%). Again this contrasts with the antenatal SRQ data where 6.67% women answered yes to thinking about suicide and 13.8% answered yes to two or more of the suicidality questions.

9.4 Power

As detailed in section 4.1, the assumptions made for the power calculation were that: the prevalence of each primary outcome (composite measure for the baby and postnatal depression for the mother) was 15%, 41% of pregnancies were unplanned and there would be at least at 25% difference in outcomes between planned and unplanned pregnancies (13.6% v 17.0%). Setting power (β) at 80% and a significance level (α) of 0.05 gave a sample size of 3,737.

After loss to follow-up I had outcome data on 3,984 pregnancies, exceeding the estimated required sample size. The prevalence of the composite adverse pregnancy outcome measure was 18.0%, higher than the 15% estimate, whereas the prevalence of postnatal depression was 7.17%, below the 15% estimate and potentially leaving this analysis under-powered. The lower prevalence of postnatal depression may be because of the timing of the assessment as we were asking about the neonatal period whereas postnatal depression may not arise until later.

Using the antenatal LMUP score to dichotomise women into planned and unplanned pregnancies, 55.2% were unplanned. This is higher than estimated and nearer to 50%, both of which should mean greater power. In addition, the LMUP score was used as a continuous measure not as a binary measure, which should also increase the power.

In summary, the analysis of adverse pregnancy outcome using the composite measure of miscarriage, stillbirth, low birthweight and neonatal death is sufficiently powered. The analysis of postnatal depression may not be sufficiently powered given the lower than estimated prevalence of postnatal depression, however the higher proportion of unplanned

pregnancies, the fact that the prevalence is nearer to 50% and the use of LMUP score as a continuous measure may increase the power for this analysis.

9.5 Antenatal factors

The World Health Organization recommends that the first antenatal visit, known as the 'booking' visit, should occur within the first trimester (12 weeks) of pregnancy and that women should attend antenatal care (ANC) at least four times during their pregnancy (353). In this section I describe the ANC behaviours and test the hypotheses that lower LMUP scores are associated with lower uptake of these preventative care practices. Secondly, I examine whether lower uptake of ANC behaviours is associated with miscarriage.

9.5.1 Attendance at antenatal care

99.2% of women said that they had attended ANC at least once; just 31 women said that they did not.

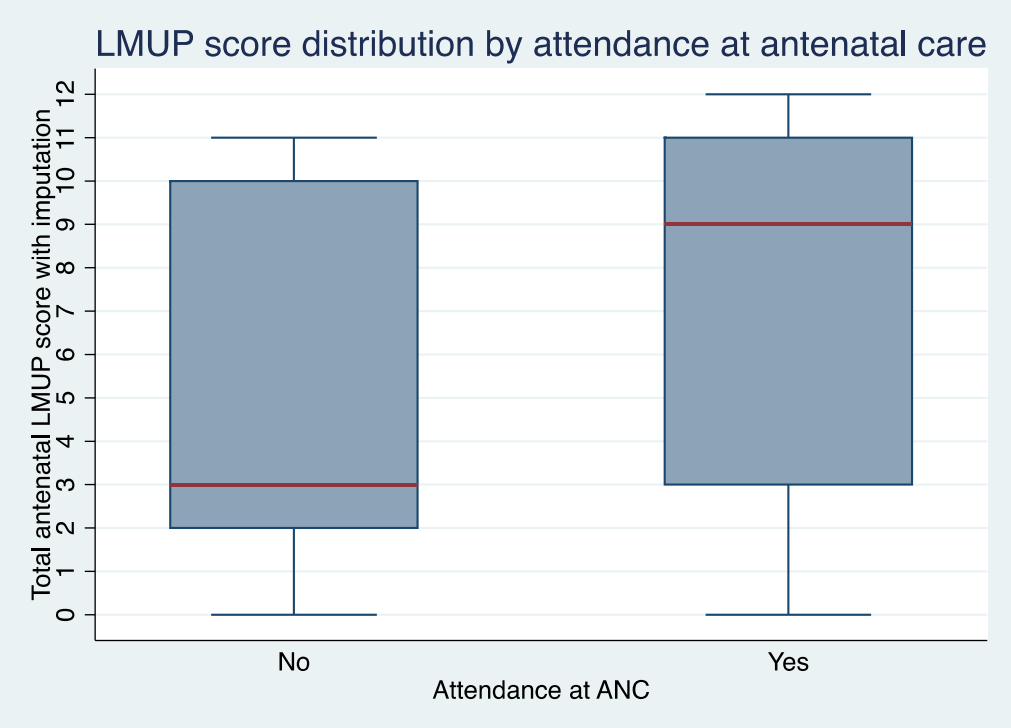


Figure 9-5 Box and whisker plot of LMUP distribution by attendance at antenatal care

The median LMUP score of the women who did not attend ANC was three, statistically significantly lower than the median LMUP score of the women

who did attend ANC, which was nine (p=0.002), as shown in Figure 9-5. From the logistic regression, for every one-point increase in LMUP score women had 1.14 times the odds of going to ANC (95%CI 1.04, 1.25). This supports the hypothesis that women whose pregnancies are more planned are more likely to attend antenatal care.

9.5.2 Months at booking

Using women's report of their gestation when they went for their first antenatal appointment, women were, on average, 5.49 months pregnant (standard deviation 1.22). Only 5.94% went in the first trimester; the most common time for the first visit was at six months (33.3%) and 20% did not go for their first visit until their final trimester. The cultural issues around pregnancy disclosure described in section 4.4 may play a role here, as might other factors such as parity.

Within the limited range of booking from one to nine months, linear regression showed a small, but statistically significant, negative association between LMUP score and months at booking (-0.045, 95%CI -0.055, -0.036). This means that for every one-point increase in LMUP score there is a reduction of -0.045 months in the time from conception to first antenatal appointment. This supports the hypothesis that women whose pregnancies are more planned tend to attend antenatal care earlier.

9.5.3 Total antenatal attendances

The average number of attendances at ANC was 3.13 (standard deviation 1.06) and the number of visits ranged from zero to nine. Most women (75%) went to ANC between two and four times; only a third of women went four or more times, which is the recommendation.

There was a small, but statistically significant, positive relationship between LMUP score and the total number of antenatal attendances on linear regression (0.038, 95%CI 0.030, 0.046). This means that for every one-point increase in LMUP score the number of antenatal appointments increases by 0.038. This supports the hypothesis that women whose pregnancies are

more planned attend ANC more than those whose pregnancies are less planned.

9.5.4 Iron / folic acid supplementation

Women in Malawi should be given a supplement containing both iron and folic acid to take during pregnancy when they attend antenatal care. Just 4.3% of women (n=171) said that they 'never' took this supplement during their pregnancy. The remainder were fairly evenly split between taking it for less than half of their pregnancy ('some days', 46.1%) or more than half of their pregnancy ('every day', 49.6%).

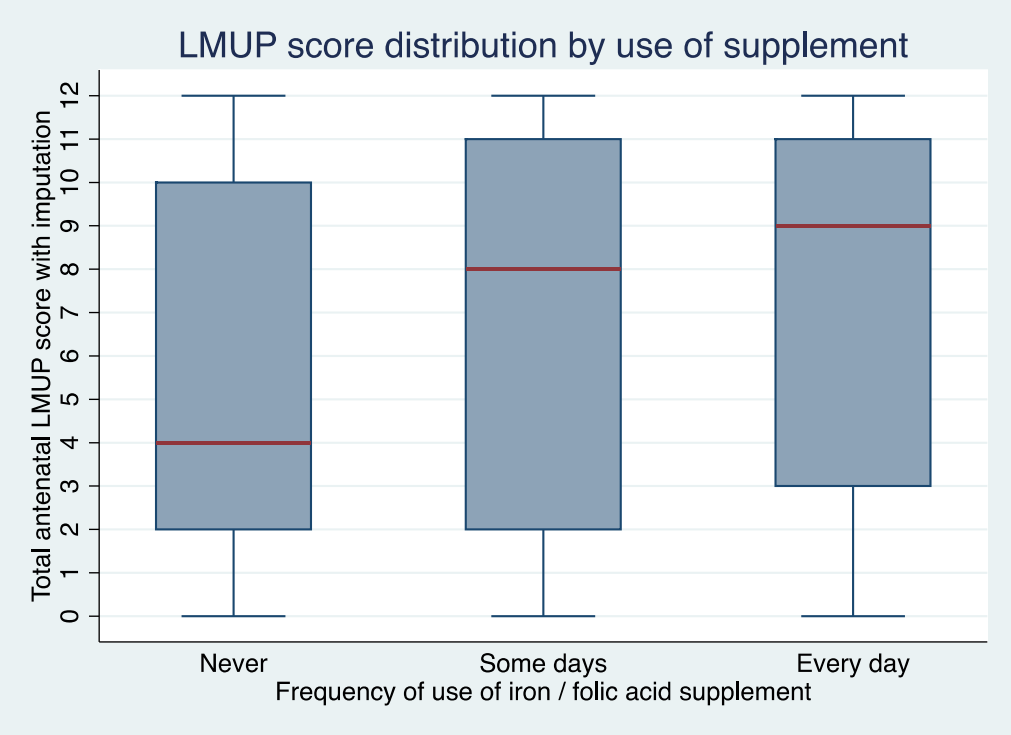


Figure 9-6 Box and whisker plot of LMUP distribution by use of iron/folic acid supplement

As shown in Figure 9-6, there was evidence of a trend with women who 'never' took this supplement having a median LMUP score of four, those who took it for less than half of their pregnancy having a median LMUP score of eight and those who reported taking it for more than half of their pregnancy having a median LMUP score of nine (p=0.001). Ordinal logistic regression showed that for a one-point increase in LMUP score, women had 1.03 times the odds of moving from either the 'never' to the 'some days' category or of

moving from the 'some days' to the 'every day' category (95%CI 1.02, 1.05). This supports the hypothesis that women whose pregnancies are more planned are more likely to take iron/folic acid supplementation.

9.5.5 Malaria prevention

Malaria is a serious risk to the woman and her baby during pregnancy. Two main preventative actions can be taken – sleeping under an insecticide treated net (ITN) and taking intermittent preventative treatment during pregnancy (IPTp). Women were asked about both of these behaviours.

9.5.5.1 Intermittent preventative treatment during pregnancy

94.7% of women (n=3,770) said that they did take medication to prevent malaria during their pregnancy. The median LMUP score of women who did not take IPTp was five, statistically significantly lower than women who did take IPTp at nine (p=0.008), as shown in Figure 9-7.

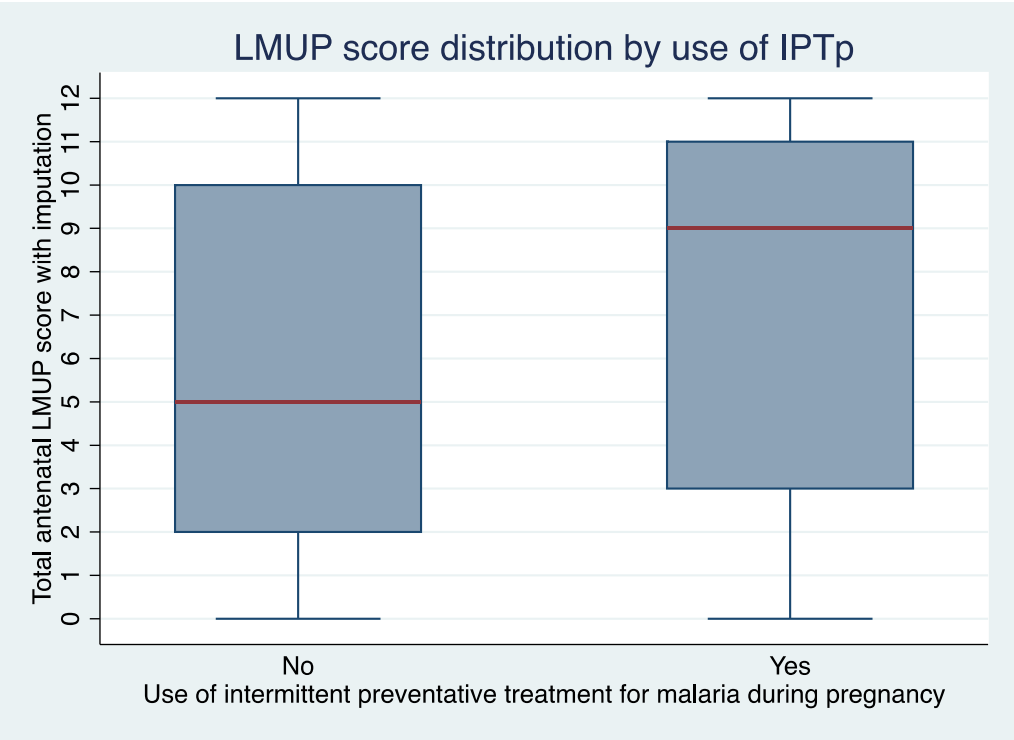


Figure 9-7 Box and whisker plot of LMUP distribution by use of IPTp

Logistic regression showed that for every one-point increase in LMUP score, women had 1.05 times the odds of taking IPTp (95%CI 1.01, 1.08). This

supports the hypothesis that women whose pregnancies are more planned are more likely to take IPTp.

9.5.5.2 Insecticide treated nets

Most households (n=3,659, 91.8%) owned at least one ITN. Of those households with an ITN, 42.2% had one, 46.6% had two and the remaining 11.2% had three to six ITNs. The majority (n=2,859, 78.4%) were pre-treated nets; of those that were not pre-treated (n=788) only 149 (18.9%) had been treated recently.

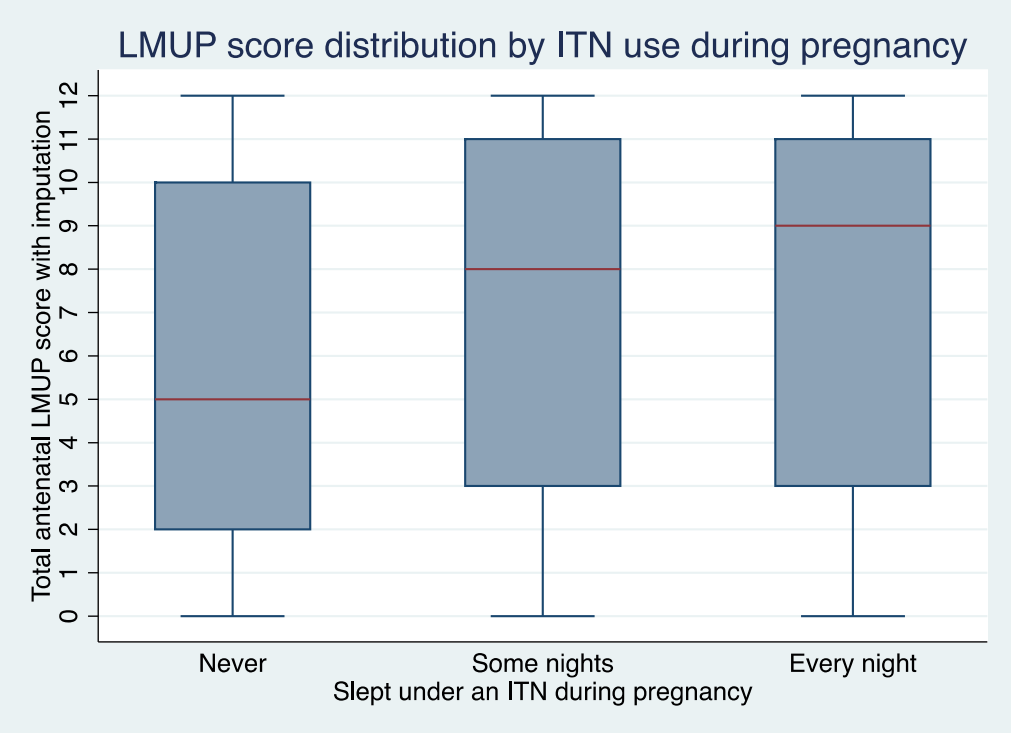


Figure 9-8 Box and whisker plot of LMUP distribution by use of an ITN during pregnancy

Of the women who had an ITN, 81.3% (n=2,976) said that they slept under it 'every' night while they were pregnant, 11.6% said they slept under an ITN 'some' nights and 7.11% said that they 'never' did. There was a clear trend between LMUP score and sleeping under an ITN during pregnancy, as shown in Figure 9-8. Women who never slept under an ITN had a median LMUP score of five; those who slept under an ITN some nights or every night had median LMUP scores of eight and nine respectively (p=0.001).

Ordinal logistic regression showed that for a one-point increase in LMUP score, women had 1.03 times the odds of moving from either the 'never' to the 'some' category or of moving from the 'some' to the 'every' category (95%CI 1.00, 1.05, p=0.016). This supports the hypothesis that women whose pregnancies are more planned are likely to take sleep under an ITN more frequently than those whose pregnancies are less planned.

9.5.6 Tetanus vaccination

Tetanus toxoid vaccination (TTV) during pregnancy, given during ANC, is important to prevent neonatal tetanus. Of the 3,948 women who attended ANC, 89.0% of women (n=3,514) said that they had had at least one tetanus vaccination.

The median LMUP score of women who did not have TTV was 4.5, statistically significantly lower than women who did have TTV at nine (p=0.001), as shown in Table 9-3. Logistic regression showed that for every one-point increase in LMUP score, women had 1.09 times the odds of having had TTV (95%CI 1.06, 1.12). This supports the hypothesis that women whose pregnancies are more planned are more likely have TTV.

TTV uptake with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	434	11.0%	4.5	2-10
Yes	3,514	89.0%	9	3-11
Total	**3,948**	**100%**	**9**	**3-11**

Table 9-3 Antenatal LMUP score by uptake of TTV

9.5.7 Voluntary Counselling and Testing for HIV

Without asking them for the result, women were asked whether they had ever had voluntary counselling and testing (VCT) for HIV; 94.5% said that they had (n=3,754).

Women who had not been tested had a median LMUP score of four compared to a median LMUP score of nine for those who had (p=0.001), as shown in Table 9-4. The logistic regression showed that for every one-point increase in LMUP score, women had 1.10 times the odds of having had an

HIV test (95%CI 1.06, 1.14). This supports the hypothesis that women whose pregnancies are more planned are more likely to have had an HIV test than those whose pregnancies are less planned. Women who had attended ANC at least once were more likely to have had an HIV test and every additional attendance at ANC increased the odds of having had an HIV test by 2.03 times (95%CI 1.77, 2.33).

VCT uptake with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	218	5.49%	4	2-10
Yes	3,754	94.5%	9	3-11
Total	**3,972**	**100%**	**9**	**3-11**

Table 9-4 Antenatal LMUP score by uptake of VCT

9.5.8 Antenatal problems

690 women (17.4%) reported experiencing at least one health problem during their pregnancy. Problems included headaches, backache, swollen legs and bleeding.

Women who experienced at least one antenatal health problem had a lower median LMUP score (seven) than women who reported no problems (nine, p=0.045). Women with higher LMUP scores had marginally lower odds of experiencing antenatal health problems (OR 0.98, 95%CI 0.96, 0.99) supporting the hypothesis that women with more planned pregnancies are less likely to experience health problems antenatally.

9.5.9 Antenatal maternal mental health

Antenatal SRQ score was strongly associated with antenatal LMUP score. Women who screened positive on the antenatal SRQ (a score of more than seven) had a median LMUP score of four compared to a median of nine for those who scored below seven on the antenatal SRQ, as shown in Figure 9-9 ($p<0.001$).

Each one-point increase in LMUP score was associated with reduced odds of screening positive on the antenatal SRQ (OR 0.89, 95%CI 0.87, 0.90). Using linear regression on the full range of antenatal SRQ scores showed

that each one-point increase in LMUP score was associated with a reduction of 0.19 points on the antenatal SRQ score (95%CI- 0.22, -0.16). This supports the hypothesis that women whose pregnancies are more planned are less likely to have antenatal mental health problems but, as the LMUP and SRQ were measured at the same time, we cannot say whether the unplanned pregnancy led to the mental health problems or vice versa.

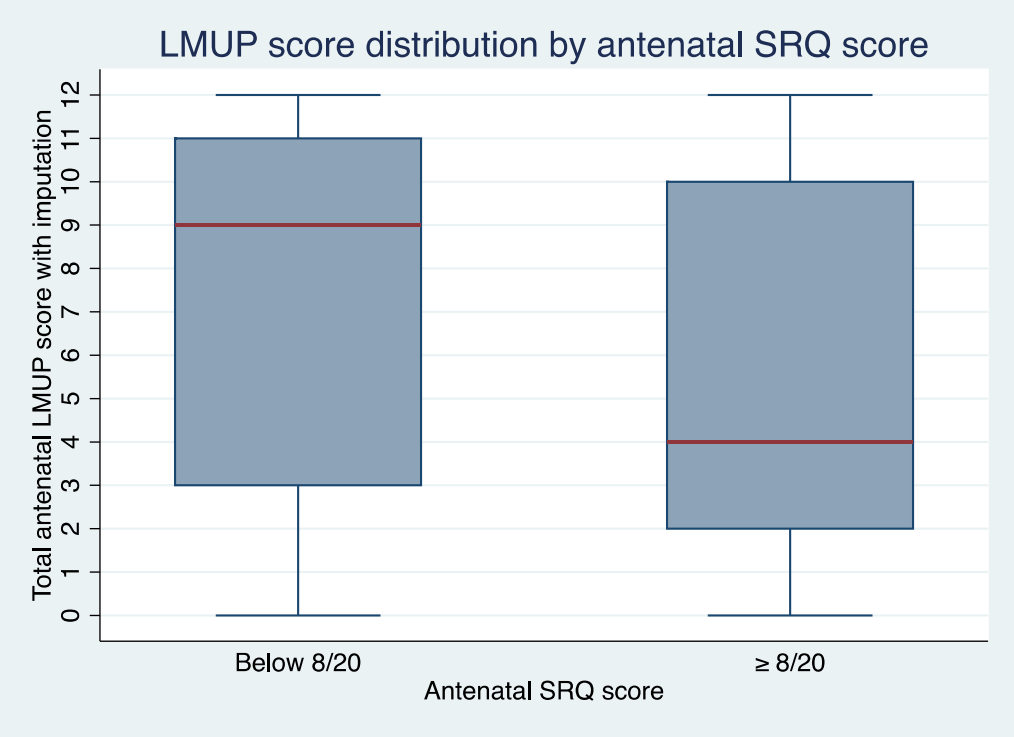


Figure 9-9 Box and whisker plot of LMUP distribution by antenatal SRQ score

9.5.10 Summary of findings for antenatal factors

All of the antenatal factors considered here were statistically significantly associated with LMUP score in the way that had been hypothesised. Women with higher LMUP scores (pregnancies that were more intended) were more likely to attend ANC and to attend earlier and more times than women whose pregnancies were less intended. They were also more likely to take preventative actions such as IPTp and sleeping under an ITN for malaria prevention, taking iron/folic acid supplements, having TTV or being tested for HIV. They were less likely to experience health problems antenatally, including mental health problems. It is possible that these results are affected by desirability bias, for example women saying that they

had taken the iron/folic acid supplement or slept under an ITN when they had not because they wanted to be seen to have done it. Nevertheless, the fact that I still found significant differences suggests that this was not too much of a problem.

9.5.11 Relationship of antenatal factors with miscarriage

The association of each of the antenatal factors with miscarriage was considered using univariate logistic regression and is shown in Table 9-5.

	Logistic regression[xxvi]			
	OR	95%CI		p-value
Attended ANC	**0.04**	**0.02**	**0.10**	**<0.001**
Months at booking	**0.76**	**0.64**	**0.91**	**0.003**
Total ANC attendances	**0.45**	**0.36**	**0.54**	**<0.001**
Iron/folic acid		**Never as baseline**		
- some days	**0.26**	**0.13**	**0.51**	**<0.001**
- every day	**0.29**	**0.15**	**0.57**	**<0.001**
IPTp	**0.29**	**0.16**	**0.52**	**<0.001**
Slept under an ITN		Never as baseline		
- some days	1.87	0.67	5.19	0.233
- every day	1.01	0.40	2.53	0.985
TTV	**3.31**	**1.04**	**10.5**	**0.043**
VCT	**0.32**	**0.18**	**0.59**	**<0.001**
Antenatal problems	**1.15**	**0.68**	**1.94**	**0.033**
Antenatal SRQ score	1.01	0.62	1.66	0.959

Table 9-5 The univariate associations of antenatal factors with miscarriage

A lower risk of miscarriage was associated with having attended ANC, more attendances at ANC, taking iron/folic acid supplementation or IPTp or having had VCT. Receiving TTV or experiencing antenatal problems were associated with an increased risk of miscarriage. Later booking at ANC was associated with lower risk of miscarriage; this may be due to reverse causality as if the pregnancy survived to have a first antenatal appointment after 28 weeks then the risk of miscarriage has passed. There were no relationships between antenatal SRQ score or sleeping under an ITN and miscarriage.

[xxvi] Significant results are shown in bold.

The only factor in this analysis that was also listed as a risk factor for miscarriage in Table 3-2 is iron/folic acid supplementation. The other factors in Table 3-2 were mostly socio-demographic; antenatal care factors were not considered by the studies from which I drew the risk factors, in part because they were looking at early miscarriage. The data from my research could be used to investigate the determinants of miscarriage (excluding early miscarriage and abortion) in this population through multivariate analysis.

9.6 Delivery factors

The World Health Organization recommends that all women should deliver in a setting providing skilled attendance (354). This means both a skilled attendant and a facilitating environment i.e. one containing the required resources and referral systems. In this section I describe the delivery behaviours and test the hypotheses that higher LMUP scores are associated with uptake of good care practices such as skilled attendance. Secondly, I examine whether these antenatal and delivery practices are associated with stillbirth or low birthweight.

9.6.1 Location of delivery

As Table 9-6 shows, the most common place for women to deliver was in a local health centre (58.6%) followed by Mchinji District Hospital (MDH) (33.1%), which is the local facility for some. There was a clear trend in median LMUP score by place of delivery ($p<0.001$), with women with higher median LMUP scores delivering in higher levels of the health system.[xxvii]

[xxvii] Home would be considered the 'worst' option, with health centre representing the first level of the health system and MDH representing the highest local level. Most of the 'other' category delivered at hospitals outside Mchinji District, including tertiary referral centres, hence they were the highest classification overall. For the multivariate regression analyses health centre was used as the baseline as it was the most common.

Delivery location with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
Home	210	5.39	5	2-11
Transit	53	1.39	6	2-10
Health centre	2,280	58.6	8	3-10
MDH	1,287	33.1	9	3-11
Other	63	1.62	9	2-11
Total	**3,893**	**100**	**9**	**3-11**

Table 9-6 Antenatal LMUP score by place of delivery

Ordinal logistic regression confirmed that increasing LMUP score was associated with delivering in a higher level of the health system. For each one-point increase in the antenatal LMUP score women had 1.03 the odds of delivering in a higher level of the health system (95%CI 1.02, 1.05). This supports the hypothesis that women with more planned pregnancies are more likely to seek a facility-based delivery.

9.6.2 Transfers during labour

Although less than 1% of women experienced a transfer during labour, women who had to move during labour had significantly lower LMUP scores than women who did not (median three versus nine, p=0.022).

9.6.3 Skilled birth attendant

Most women reported having a skilled birth attendant deliver their child and women who had a skilled birth attendant had a statistically significantly higher median LMUP score that those who did not (p=0.0008), as shown in Table 9-7.

Skilled birth attendant use with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	394	10.1	6	2-10
Yes	3,498	89.9	9	3-11
Total	**3,892**	**100**	**9**	**3-11**

Table 9-7 Antenatal LMUP score by use of skilled birth attendant

Logistic regression showed that for each one-point increase in LMUP score, women had 1.04 the odds of having a skilled birth attendant (95%CI 1.01,

1.07). This supports the hypothesis that women with more planned pregnancies are more likely to seek a delivery from a skilled birth attendant.

9.6.4 Clean delivery practices

Women were asked whether the person delivering their baby had washed their hands and/or used gloves. This was used to create a categorical variable for deliveries where the person delivering the baby had both washed their hands and used gloves, where they had done either of these or whether they had done neither. There was a high level of missing data for these questions (23.4%) but, of those who answered, most women (85.5%) reported that the provider had both washed their hands and used gloves, as shown in Table 9-8.

Deliverer washed hands/used gloves with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
Both	2,547	85.5	8	2-11
Either	385	12.9	10	3-11
Neither	47	1.58	10	3-11
Total	**2,979**	**100**	**9**	**3-11**

Table 9-8 Antenatal LMUP score by how clean the delivery was

There was a significant negative relationship between LMUP score and clean delivery practices ($p<0.001$) that was unexpected. This is not consistent with the hypothesis that women with more planned pregnancies are more likely have a clean delivery than women with less planned pregnancies, however we should be cautious about this conclusion given the high level of missing data. As these are self-reported data there is scope for bias as women whose pregnancies are more planned may be more likely to notice if there are sub-optimal conditions during their delivery.

9.6.5 Duration of labour

For just over half of women, labour lasted less than six hours. There was a visible trend whereby women who had reported their pregnancies as more unintended antenatally had longer labours. However, this was not significant ($p=0.75$), suggesting there is little evidence that less planned pregnancies are associated with longer labours.

Duration of labour (hrs) with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
0-6	1,948	51.4	9	3-11
7-12	1,070	28.2	9	2-11
13-18	386	10.2	9	3-11
19-24	210	5.54	8	3-11
> 24	177	4.67	6	2-10
Total	**3,791**	**100**	**9**	**3-11**

Table 9-9 Antenatal LMUP score by duration of labour

9.6.6 Mwana mphepo

Mwana mphepo is a traditional herbal medicine used to speed up labour. Literally translated from Chichewa it means 'child of the wind'; in this context it means 'baby come quickly' and is used to speed up and strengthen contractions. Because of this it has been associated with uterine rupture and its use is discouraged. Table 9-10 shows that about 14% of women used mwana mphepo. These women had a median LMUP score of nine but this was not statistically significantly different from women who had not used mwana mphepo (eight, p=0.09), indicating little evidence that women with less planned pregnancies are more likely to use mwana mphepo.

Used mwana mphepo with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	3,332	85.7	8	3-11
Yes	556	14.3	9	3-11
Total	**3,888**	**100**	**9**	**3-11**

Table 9-10 Antenatal LMUP score by use of mwana mphepo

9.6.7 Mode of delivery

Most babies (93.4%) were born by normal delivery[xxviii] as shown in Table 9-11. There was no difference in the LMUP scores of women whose babies were or were not born by normal delivery (p=0.166). The proportion of births by Caesarean sections was very low (4.07% of all births). As this is lower than 5% this indicates a potential unmet need for Caesarean sections in Mchinji District (355).

[xxviii] Non-normal deliveries included breech and instrumental deliveries or Caesarean sections.

Normal delivery with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	262	6.60	9	3-11
Yes	3,693	93.4	8	3-11
Total	**3,955**	**100**	**9**	**3-11**

Table 9-11 Antenatal LMUP score by normal delivery

9.6.8 Delivery problems

351 women (9.1%) reported experiencing at least one problem during delivery. Problems reported included long labours, breech presentations and bleeding.

Women who experienced delivery problems had a statistically significantly lower median LMUP score (seven) than women who reported no problems (nine, p=0.038). Women with higher LMUP scores had marginally lower odds of experiencing delivery problems (OR 0.97, 95%CI 0.95, 1.00 p=0.048) suggesting that women with more planned pregnancies are less likely to experience delivery problems.

Delivery problems with median LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	3,528	90.9	9	3-11
Yes	351	9.10	7	2-10
Total	**3,879**	**100**	**9**	**3-11**

Table 9-12 Antenatal LMUP score by experience of problems during delivery

9.6.9 Multiple births and gender

3.11% of babies born were one of twins or triplets. There was no relationship between antenatal LMUP score and whether the woman had a multiple pregnancy (p=0.100) or between antenatal LMUP score and the gender of the baby (p=0.330).[xxix]

9.6.10 Summary of findings for delivery factors

The findings for delivery behaviours were more mixed than the relationships seen between LMUP score and antenatal behaviours. As hypothesised,

[xxix] Women are unlikely to know that they have a multiple pregnancy or the gender of the baby prior to birth given the absence of an ultrasound scanner in Mchinji District.

women whose pregnancies were more unplanned (lower LMUP score) were more likely to deliver at home, to deliver without a skilled birth attendant, to be transferred during labour and to experience delivery problems. There was also a non-significant trend for them to have longer labours. However, there was no evidence that more planned pregnancies had cleaner deliveries, though this may be due to the high level of missing data for this variable. There was no relationship between LMUP score and the use of mwana mphepo, a potentially harmful traditional medicine.

9.6.11 Relationship of antenatal and delivery factors with stillbirth

The association of each of the antenatal and delivery factors with stillbirth was considered using univariate logistic regression and is shown in Table 9-13.

Women who attended ANC or who had a normal delivery were less likely to experience a stillbirth. The odds of a stillbirth were increased in women who experienced antenatal problems, including antenatal mental health problems, who delivered anywhere other than their local health facility, who had to be transferred during labour, who experienced longer labours or problems during the delivery and in women who had a multiple birth. Home deliveries were associated with a greater risk of stillbirth, as were births in MDH or other health facilities outside of Mchinji District; this may reflect the case mix as higher risk pregnancies are referred to MDH or out of Mchinji District for delivery.

These findings are consistent with the risk factors for stillbirth drawn from the literature in Table 3-3, with the addition of delivery location, a factor more pertinent to LICs. The data from this research could be used in a multivariate analysis to investigate the determinants of stillbirth in Mchinji District.

	Logistic regression			
	OR	**95%CI**		**p-value**
Attended ANC	**0.10**	**0.03**	**0.34**	**<0.001**
Months at booking	0.89	0.73	1.09	0.264
Total ANC attendances	0.89	0.70	1.13	0.347
Iron/folic acid		Never as baseline		
- some days	0.84	0.25	2.79	0.946
- every day	0.89	0.27	2.95	
IPTp	0.51	0.22	1.20	0.125
Slept under an ITN		Never as baseline		
- some days	1.25	0.31	5.03	0.782
- every day	1.46	0.45	4.71	
TTV	0.56	0.31	1.15	0.123
VCT	0.67	0.26	1.67	0.387
Antenatal problems	**2.37**	**1.41**	**3.98**	**0.001**
Antenatal SRQ score	**1.96**	**1.18**	**3.25**	**0.010**
Delivery location		Health centre as baseline		
- transit			None	
- home	**2.62**	**0.98**	**7.01**	
- MDH	**3.15**	**1.83**	**5.40**	**0.002**
- other	**5.34**	**1.56**	**18.4**	
Transfer in labour	**5.40**	**1.62**	**18.0**	**0.006**
SBA	0.94	0.43	2.08	0.887
Clean delivery	Both (gloves and washed hands) as baseline			
- either	2.18	1.10	4.34	
- neither	1.64	0.22	12.2	0.082
Labour duration		0-6hrs as baseline		
-7-12 hrs	**2.22**	**1.21**	**4.10**	
-13-18 hrs	**3.45**	**1.69**	**7.05**	**0.007**
-19-24 hrs	**2.97**	**1.71**	**7.50**	
> 24 hrs	**2.30**	**0.77**	**6.82**	
Mwana mphepo	0.38	0.14	1.06	0.063
Normal delivery	**0.22**	**0.13**	**0.38**	**<0.001**
Delivery problems	**5.12**	**3.03**	**8.64**	**<0.001**
Multiple birth	**7.70**	**4.00**	**14.8**	**<0.001**
Female baby	0.62	0.37	1.03	0.066
Low birthweight	1.56	0.77	3.13	0.214

Table 9-13 The univariate associations of antenatal and delivery factors with stillbirth

9.6.12 Relationship of antenatal and delivery factors with low birthweight

Table 9-14 shows the univariate associations between antenatal and delivery factors and low birthweight, as found on logistic regression, though clearly delivery factors are not causes of low birthweight.

Experiencing antenatal or delivery problems, having a longer duration of labour, more than one baby or a female baby were associated with an increased risk of low birthweight, though the relationship for antenatal problems was of borderline significance. Low birthweight babies were less likely to have a normal delivery. The other relationships were all in the direction of estimated effect, for example attending ANC, taking iron/folic acid and sleeping under an ITN were all associated with reduced odds of having a low birthweight baby, but none of these relationships were statistically significant.

These findings are consistent with the risk factors for low birthweight drawn from the literature in Table 3-4 with the exception of normal delivery and delivery problems, which had not been mentioned. The data from this research could be used in a multivariate analysis to investigate the determinants of low birthweight, including socio-demographic and anthropometric factors thought or known to be important but not considered here.

	Logistic regression			
	OR	**95%CI**		**p-value**
Attended ANC	0.83	0.18	3.69	0.802
Months at booking	0.95	0.88	1.03	0.219
Total ANC attendances	0.98	0.89	1.08	0.650
Iron/folic acid		Never as baseline		
- some days	0.74	0.43	1.27	0.502
- every day	0.80	0.46	1.36	
IPTp	0.83	0.50	1.38	0.473
Slept under an ITN		Never as baseline		
- some days	0.76	0.47	1.24	0.111
- every day	0.67	0.46	0.98	
TTV	0.95	0.68	1.31	0.739
VCT	0.77	0.49	1.20	0.245
Antenatal problems	**1.27**	**0.99**	**1.64**	**0.057**
Antenatal SRQ score	1.02	0.99	1.05	0.113
Delivery location		Health centre as baseline		
- transit	0.68	0.13	3.67	
- home	0.69	0.21	2.28	
- MDH	1.05	0.85	1.29	0.733
- other	1.27	0.58	2.76	
Transfer in labour	0.97	0.34	2.76	0.951
Skilled birth attendant	1.07	0.61	1.89	0.808
Clean delivery	Both (gloves and washed hands) as baseline			
- either	1.2	0.95	1.51	0.243
- neither	0.51	0.67	3.89	
Labour duration		**0-6hrs as baseline**		
-7-12 hrs	**1.28**	**1.00**	**1.64**	
-13-18 hrs	**1.51**	**1.06**	**2.14**	**0.011**
-19-24 hrs	**1.37**	**0.86**	**2.17**	
> 24 hrs	**1.88**	**1.24**	**2.88**	
Mwana mphepo	0.38	0.14	1.06	0.063
Normal delivery	**0.69**	**0.48**	**0.99**	**0.044**
Delivery problems	**5.12**	**3.03**	**8.64**	**<0.001**
Multiple birth	**14.4**	**9.20**	**22.5**	**<0.001**
Female baby	**1.48**	**1.21**	**1.81**	**<0.001**
Stillbirth	1.51	0.78	2.92	0.216

Table 9-14 The univariate associations of antenatal and delivery factors with low birthweight

9.7 Postnatal factors

In this section I describe the postnatal behaviours relating to breastfeeding, health problems and care practices for woman and baby. I test the hypotheses that lower LMUP scores are associated with lower uptake of preventative care practices such as breastfeeding and immunisation. Secondly, I examine whether lower uptake of these behaviours is associated with neonatal death or postnatal maternal mental health status.

9.7.1 Breastfeeding

The World Health Organization recommends that babies should be exclusively breastfed for the first six months of life (356). Breastfeeding is a very common practice in Malawi; 98.6% of babies were ever breastfed and most of these are still receiving some breastmilk at the age of one (22).

9.7.1.1 Initiation of breastfeeding

Just 1% (n=40) of the babies who were born alive were never breastfed. There was no significant difference in LMUP score between women who had ever or had never breastfed their baby (p=0.885). There is little evidence to indicate a relationship between LMUP score and the initiation of breastfeeding, though this analysis is limited by the fact that so few babies were never breastfed.

Women were asked how long after birth they first put their baby to the breast. This ranged from immediately to two days after birth (mean 29.8mins, median 20mins). There was no relationship between LMUP score and the timing of the initiation of breastfeeding (p=0.25), suggesting that there is little evidence that women who have more planned pregnancies are likely to breastfeed their babies sooner.

9.7.1.2 Continuation of breastfeeding

Only two women whose babies were still alive had stopped breastfeeding at the time of the postnatal interview, so it was not really possible to test whether there was a relationship between LMUP score and continuation of breastfeeding. These women had a lower median LMUP scores (three) than

women who were still breastfeeding (nine) but, given the small number, this was not statistically significant (p=0.226).

9.7.1.3 Exclusive breastfeeding

Of the women still breastfeeding only 8.97% (n=339) were not exclusively breastfeeding at the time of the postnatal interview. The median LMUP score of those who were exclusively breastfeeding was nine compared to seven for those who were not exclusively breastfeeding. This difference was of borderline significance (p=0.053) suggesting some evidence that women whose pregnancies are more planned are more likely to exclusively breastfeed their babies for longer.

9.7.2 Postnatal check

Almost 80% of women said that they attended the recommended postnatal check. Those who did attend had a statistically significantly higher median LMUP score than those who did not, as shown in Table 9-15 (p=0.005).

Attended postnatal check with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	787	20.5	6	2-10
Yes	3,047	79.5	9	3-11
Total	**3,834**	**100**	**9**	**3-11**

Table 9-15 Antenatal LMUP score by attendance at the one-week postnatal check

Each one-point increase in LMUP score was associated with 1.03 times increased odds of attending the postnatal check (95%CI 1.01, 1.05). This confirms that women with more planned pregnancies are more likely to utilise postnatal care.

9.7.3 Maternal postnatal problems

Nearly 10% of women reported postnatal health problems including anaemia, headaches, malaria and abdominal pains. There was no difference in LMUP score between those who did and those who did not experience postnatal health problems (p=0.814) indicating that there is little evidence that more planned pregnancies are associated with fewer maternal postnatal problems.

9.7.4 Immunisation

Malawi's immunisation schedule recommends that both Bacillus Calmette–Guérin (BCG) for tuberculosis and oral polio vaccine (OPV) for polio be given at birth.

9.7.4.1 Tuberculosis immunisation

10% of live births had not received the BCG vaccination by the time of the postnatal interview, despite the fact that this immunisation should be given at birth. The median LMUP score of women whose babies had not had BCG immunisation was lower than women whose babies had been immunised (seven verses nine) but this was not statistically significant (p=0.064). This is suggestive, but not confirmatory, evidence that the babies of more unplanned pregnancies may be less likely to receive the BCG immunisation.

BCG given with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	402	10.4	7	2-10
Yes	3,481	89.7	9	3-11
Total	**3,883**	**100**	**9**	**3-11**

Table 9-16 Antenatal LMUP score by uptake of BCG vaccine

9.7.4.2 Polio immunisation

Similarly, 15% of live births had not received OPV by the time of the postnatal interview, even though this immunisation should also be given at birth. The median LMUP score of women whose babies had not had OPV immunisation was lower than women whose babies had been immunised (eight verses nine) but this was only of borderline statistical significance (p=0.058). This is also suggestive, but not confirmatory, evidence that the babies of more unplanned pregnancies may be less likely to receive OPV immunisation.

OPV given with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	586	15.1	8	2-10
Yes	3,297	84.9	9	3-11
Total	**3,883**	**100**	**9**	**3-11**

Table 9-17 Antenatal LMUP score by uptake of OPV vaccine

For both BCG and OPV there were strong relationships between the place of delivery and the person delivering the baby and whether or not vaccinations were given, which may confound these relationships. Furthermore, if neonatal deaths are excluded from the analysis the relationships between LMUP score and BCG and OPV become significant (p=0.0287 and p=0.0412 respectively). Babies who died on the first day of life may have died before being given the vaccination and if the babies who died in the first month (two-thirds of whom died in the first week) were recognised to be ill, vaccination may have been contraindicated. These data suggest that babies who do not die in the first month of life are less likely to be vaccinated with either BCG or OPV if they are the result of a less planned pregnancy.

9.7.5 Baby sleeping under an ITN

87.6% of babies slept under an ITN the night before the postnatal interview took place. The median antenatal LMUP score of women whose babies had not slept under an ITN the night before the interview was statistically significantly lower than that of women whose babies had, as shown in Table 9-18 (p=0.0004).

Baby slept under ITN last night with LMUP score				
	Freq.	**Percent.**	**Median**	**IQR**
No	459	12.4	6	2-10
Yes	3,250	87.6	9	3-11
Total	**3,709**	**100**	**9**	**3-11**

Table 9-18 Antenatal LMUP score by whether the baby slept under an ITN last night

For each one-point increase in antenatal LMUP score, babies had 1.05 times the odds of having slept under an ITN the night before the postnatal interview (95%CI 1.02, 1.07). This suggests that the babies of more planned pregnancies are more likely to be sleeping under an ITN.

9.7.6 Baby health problems

Women were asked whether their baby had experienced any of a number of common symptoms, including cough, fever, jaundice, diarrhoea and fast breathing, since birth. The most common symptom experienced was cough, followed by fever, as shown in Table 9-19.

	Yes		No	
Symptom	**Freq.**	**Percent.**	**Freq.**	**Percent.**
Cough	1,379	35.5	2,504	64.5
Fever	843	21.7	3,039	78.3
Diarrhoea	201	5.2	3,683	94.8
Fast breathing	125	3.2	3,757	96.8
Feeding problem	111	2.9	3,773	97.1
Jaundice	80	2.1	3,790	97.9
Cord infection	71	1.8	3,808	98.2

Table 9-19 Prevalence of symptoms in the baby

The mothers of babies who had experienced at least one health problem had lower median LMUP scores (eight) than the mothers of babies who had no problems (nine). Logistic regression showed that for every one-point increase in their mother's LMUP score, babies had 0.98 times the odds of having a health problem (95%CI 0.96, 1.00, p=0.042). This supports the hypothesis that the babies of women whose pregnancies are more planned are less likely to have health problems after birth than the babies of women whose pregnancies are less planned.

9.7.7 Summary of findings for postnatal behaviours

Women whose pregnancies were more planned were more likely to go for a postnatal check but there was no difference in whether or not they experienced postnatal problems. It was hypothesised that women whose pregnancies were less planned (lower LMUP score) may be less likely to breastfeed, to have delayed breastfeeding initiation, to have stopped breastfeeding or stopped exclusively breastfeeding, sooner than women whose pregnancies were more planned. None of these relationships were seen, except for a suggestion that exclusively breastfeeding at the time of interview was associated with more planned pregnancies (p=0.053). The lack of observed relationships is possibly because of the very high prevalence of initiation of breastfeeding and the very small number of women who had stopped breastfeeding, or introduced other foods, by the time of the postnatal interview.

The babies of women whose pregnancies were more unplanned were less likely to have slept under an ITN the night before the interview and more

likely to experience health problems, according to the mother's report. As these illnesses were not objectively verified it could be that women who experience more unplanned pregnancies are more likely to report problems with their baby's health, rather than these babies actually experience poorer health. The babies of women whose pregnancies were more unplanned were also less likely to have had either OPV or BCG vaccinations if they were still alive at the postnatal interview.

9.7.8 Relationship of antenatal, delivery and postnatal factors with neonatal death

The antenatal, delivery and postnatal factors' relationships with neonatal death were assessed using univariate logistic regression and are shown in Table 9-20. The odds of neonatal death were higher for deliveries in a setting other than the local health facility, for less clean deliveries and for multiple births. There were reduced odds of neonatal death for normal deliveries and if the baby was ever breastfed, had been taken to the postnatal check or had had BCG or OPV. Unexpectedly, the mother having antenatal mental health problems or the baby having health problems were associated with a reduction in the risk of neonatal death. These findings are mostly consistent with the risk factors for neonatal death drawn from the literature in Table 3-3, with the addition of delivery location and clean delivery, which are factors of more relevance to low-income countries.

Logistic regression	OR	95%CI		p-value
Attended ANC	0.40	0.05	3.04	0.372
Months at booking	1.12	0.94	1.34	0.205
Total ANC attendances	0.85	0.69	1.05	0.129
Iron/folic acid		Never as baseline		
- some days	1.05	0.32	3.44	0.403
- every day	1.39	0.43	4.52	
IPTp	0.88	0.35	2.21	0.793
Slept under an ITN		Never as baseline		
- some days	9.02	1.18	69.1	0.060
- every day	5.70	0.79	41.3	
TTV	1.28	0.62	2.67	0.505
VCT	1.60	0.59	5.12	0.425
Antenatal problems	1.28	0.77	2.14	0.348
Antenatal SRQ score	**0.47**	**0.25**	**0.89**	**0.020**
Delivery location		**Health centre as baseline**		
- transit	**1.42**	**0.19**	**10.6**	
- home	**4.20**	**2.07**	**8.51**	
- MDH	**2.67**	**1.67**	**4.28**	**<0.001**
- other	**5.23**	**1.80**	**15.5**	
Transfer in labour	1.30	0.18	9.59	0.799
Skilled birth attendant	0.66	0.36	1.19	0.167
Clean delivery		**Used gloves and washed hands**		
- either	**1.30**	**0.82**	**2.07**	**0.015**
- neither	**4.60**	**1.59**	**13.3**	
Labour duration		0-6hrs as baseline		
-7-12 hrs	1.06	0.63	1.78	
-13-18 hrs	1.93	1.05	3.53	0.241
-19-24 hrs	0.70	0.21	2.83	
> 24hrs	1.09	0.39	3.09	
Mwana mphepo	1.50	0.89	2.53	0.131
Normal delivery	**0.29**	**0.17**	**0.51**	**<0.001**
Delivery problems	1.60	0.86	2.96	0.140
Multiple birth	**2.99**	**1.35**	**6.33**	**0.005**
Ever breastfed	**0.004**	**0.002**	**0.01**	**<0.001**
First breastfed		≤ 10mins as baseline		
> 10 - ≤ 20mins	1.51	0.70	3.22	
> 20 - ≤ 30mins	1.27	0.61	2.67	0.263
> 30 - ≤ 60mins	1.44	0.63	3.13	
> 60mins	3.31	1.16	9.43	
Postnatal check (all)	**0.09**	**0.06**	**0.15**	**<0.001**
Postnatal check (except early neonatal deaths)	0.48	0.19	1.20	0.116
Maternal postnatal problems	1.63	0.89	2.96	0.111
BCG	**0.04**	**0.02**	**0.06**	**<0.001**
OPV	**0.04**	**0.03**	**0.07**	**<0.001**
Baby health problems	**0.98**	**0.97**	**1.00**	**0.042**
Baby health problems all deaths	1.20	0.81	1.78	0.372

Table 9-20 The univariate associations of antenatal, delivery and postnatal factors with neonatal death

However, the potential for reverse causality is an important consideration in many of these findings. The postnatal check is recommended to take place seven days after delivery, but 69 of the 90 neonatal deaths were early neonatal deaths; deaths that occurred within the first week. Although all women are advised to attend this check for their own health, many women said that they did not attend the check because the baby had already died. Therefore it is possible that the lower odds of neonatal death observed in the babies of women who attended the postnatal check is because women whose baby died did not go to the postnatal check, rather than the postnatal check prevents neonatal deaths. To test this, I removed the early neonatal deaths from the analysis and it can be seen that the postnatal check at seven days did not have a significant effect on mortality after the first week of life (data shown in Table 9-20 as 'Postnatal check (except early neonatal deaths)').

Never having been breastfed and not having had either OPV or BCG may be because the baby died very soon after birth, so again, it may not be that the absence of these factors increases the risk of a neonatal death but that an early neonatal death precludes these actions from taking place. The cross-sectional nature of these data prevents us from drawing any causal inferences.

The interpretation of the role of reported baby health problems is also complicated. While neonatal deaths can only occur in the first month of life, the women were asked about the problems that their baby had experienced since birth – this includes a variable length of time after the neonatal period depending on when the postnatal interview took place. Babies who did not die in the first month of life had a greater period of time at risk in which to experience health problems and are greater in number. Therefore health problems may be more common in babies who did not die, which is why we see an apparent reduction in the odds of neonatal death in babies who experienced a health problem. Including post-neonatal deaths in this analysis made the relationship between health problems and death non-significant (shown in Table 9-20 as 'Postnatal problems (baby) all deaths').

9.7.9 Relationship of antenatal, delivery and postnatal factors with postnatal maternal mental health status

The antenatal, delivery and postnatal factors' relationships with postnatal maternal mental health, as measured by the SRQ score, were assessed using univariate linear regression and are shown in Table 9-21.

Factors that were associated with lower postnatal SRQ score (less likelihood of postnatal mental health problems) were: attending antenatal care, later booking, taking iron/folic acid or IPTp, sleeping under an ITN during pregnancy, having had VCT, having an unclean delivery, having a normal delivery, initiating breastfeeding more than 10 minutes after birth and having attended a postnatal check. Factors that were associated with higher postnatal SRQ score were: antenatal problems including mental health problems, miscarriage, not delivering in a health centre, longer duration of labour, delivery problems, multiple births, stillbirths and health problems for the women or for the baby after birth.

It is not clear why women who do not have a clean delivery would have lower postnatal SRQ scores; if any relationship were to be hypothesised it would probably be the other way around. Clean delivery was a variable with a lot of missing data (>23%), which may be a reason for the unexpected relationship. Later booking at antenatal care and delayed initiation of breastfeeding were associated with lower postnatal SRQ scores, which were also unexpected findings. These univariate relationships may be confounded by other factors.

Linear regression	β coeff.	95%CI		p-value
Attended ANC	**-1.84**	**-2.86**	**-0.81**	**<0.001**
Months at booking	**-0.25**	**-0.32**	**-0.18**	**<0.001**
Total ANC attendances	0.02	-0.06	0.11	0.550
Iron/folic acid		**Never as baseline**		
- some days	**-0.18**	**-0.62**	**0.27**	**<0.001**
- every day	**-1.36**	**-1.80**	**-0.91**	
IPTp	**-0.62**	**-1.02**	**-0.22**	**0.003**
Slept under an ITN		**Never as baseline**		
- some days	**-0.67**	**-1.11**	**-0.22**	**<0.001**
- every day	**-0.88**	**-1.24**	**-0.51**	
TTV	0.18	-0.11	0.47	0.221
VCT	**-0.69**	**-1.08**	**-0.29**	**0.001**
Antenatal problems	**0.62**	**0.38**	**0.86**	**<0.001**
Antenatal SRQ score	**0.30**	**0.27**	**0.32**	**<0.001**
Miscarriage	**1.05**	**0.43**	**1.67**	**0.001**
Delivery location		**Health centre as baseline**		
- transit	**-0.39**	**-1.18**	**0.40**	
- home	**0.41**	**0.01**	**0.82**	
- MDH	**0.73**	**0.53**	**0.92**	**<0.001**
- other	**0.59**	**-1.40**	**1.31**	
Transfer in labour	-0.10	-0.85	1.05	0.830
Skilled birth attendant	-0.15	-0.45	0.15	0.319
Clean delivery		**Both (gloves and washed hands) as baseline**		
- either	**-0.37**	**-0.57**	**-0.16**	**0.001**
- neither	**-0.56**	**-1.39**	**0.27**	
Labour duration		**0-6hrs as baseline**		
-7-12 hrs	**0.79**	**0.58**	**1.01**	
-13-18 hrs	**1.12**	**0.80**	**1.43**	**<0.001**
-19-24 hrs	**0.59**	**0.18**	**1.00**	
> 24 hrs	**1.11**	**0.67**	**1.55**	
Mwana mphepo	-0.26	-0.52	0.00	0.051
Normal delivery	**-1.42**	**-1.74**	**-1.09**	**<0.001**
Delivery problems	**1.24**	**0.93**	**1.56**	**<0.001**
Multiple birth	**1.07**	**0.54**	**1.59**	**<0.001**
Stillbirth	**2.18**	**1.47**	**2.89**	**<0.001**
Ever breastfed	0.08	-0.84	1.00	0.858
First breastfed		**≤ 10mins as baseline**		
> 10 - ≤ 20mins	**-0.45**	**-0.70**	**0.19**	
> 20 - ≤ 30mins	**-0.72**	**-0.95**	**-0.48**	**<0.001**
> 30 - ≤ 60mins	**-0.30**	**-0.58**	**-0.02**	
> 60mins	**0.09**	**-0.42**	**0.59**	
Exclusive breastfeeding	-0.21	-0.53	0.11	0.195
Postnatal check	**-0.35**	**-0.58**	**-0.13**	**0.002**
Maternal postnatal problems	**1.24**	**0.93**	**1.54**	**<0.001**
Baby health problems	**0.57**	**0.39**	**0.75**	**<0.001**
Neonatal death	-0.30	-0.90	0.31	0.336

Table 9-21 The univariate associations of antenatal, delivery and postnatal factors with postnatal SRQ score

The other findings are consistent with some of the risk factors for postnatal depression drawn from the literature in Table 3-6 and Table 3-7. The relationships between iron/folic acid supplementation, IPTp and ITN use may all work by reducing the risk of anaemia, which has been shown to be associated with postnatal depression (229). Many of the factors considered here, such as antenatal, delivery and postnatal problems, have not been well-covered in the literature but seem to be important. These data could later be used in a multivariate analysis to investigate the determinants of postnatal depression. This would be particularly valuable as I have data on antenatal depression, collected antenatally, previous depression and IPV so I would also be able to explore more of the natural history of perinatal depression than other studies have done.

9.8 Discussion of the relationships between pregnancy intention and maternal behaviours and care uptake

These univariate findings make several important contributions to the literature on the way in which pregnancy intention influences maternal behaviours and care uptake.

9.8.1 Antenatal factors

My findings on delayed initiation of antenatal care and fewer total visits in more unplanned pregnancies are consistent with those of Dibaba et al.'s 2013 systematic review on the topic (265). The strong association between less planned pregnancies and antenatal depression also supports the findings of my literature review in section 3.3.3.5 (63, 122, 220-227).

However, it is the findings on maternal behaviours that are of particular interest. The finding that the use of the iron/folic acid supplement is related to pregnancy intention is consistent with the patterns seen in high-income countries (HICs) (131, 239, 266, 267, 269-271). What is new is that, having used the LMUP score as a continuous measure and supplement use as an ordinal measure, we can see that the frequency of use of the supplement during pregnancy is related to how intended the pregnancy is, i.e. the more intended the pregnancy the more frequently the supplement is taken.

As I noted in section 3.3.5.2, almost all the evidence on the relationships between pregnancy intention and antenatal behaviours is from HICs and is about the consumption of alcohol and tobacco during pregnancy. I did not find any evidence on behaviours relevant to low-income countries such as IPTp use and TTV uptake, making my findings unique. From my data it seems that women with more planned pregnancies are more likely to take IPTp, sleep under an ITN and have TTV and VCT during their pregnancy than women with less planned pregnancies. They are also less likely to experience antenatal problems, including mental health problems.

9.8.2 Delivery factors

There was some evidence in the literature, discussed in section 3.3.5.3, that women with less planned pregnancies were less likely to deliver either in a health facility or with a skilled birth attendant (114, 123-125, 237), as was the case in my data. I found that women with less planned pregnancies were more likely to experience delivery problems but not a longer labour or a non-normal delivery, factors that have not been mentioned in the literature.

9.8.3 Postnatal factors

I was unable to add much to the existing evidence of higher rates and longer duration of breastfeeding in the children of intended pregnancies (105, 120, 121, 163, 168, 236, 259, 272-277), covered in section 3.3.5.4. This was due to the high initiation and low discontinuation rates for breastfeeding in the time-period of this research.

An important finding was that women who reported pregnancies that were less planned were significantly less likely to access postnatal care, though they were not more likely to experience health problems. This was not something that had been mentioned in the literature. Postnatal care is important for both the mother and the baby, especially for discussions about caring for the baby, resuming sex and starting contraception, and is a recognised gap in the continuum of care.

The current literature has mixed findings for the role of pregnancy intention on the immunisation of the child (section 3.3.5.5). My univariate analyses

suggest that babies who were still alive at the time of the postnatal interview were less likely to have had either BCG or OPV if their mothers had reported their pregnancy as more unplanned.

I found that the babies of less planned pregnancies were more likely to experience health problems, as have several other studies (279-281). These babies were also less likely to have slept under an ITN the previous night, which is a new finding.

However, all of these results are from univariate analyses. Where others have conducted multivariate analyses some of these relationships have disappeared, as observed in section 3.3.5. It was beyond the scope of this research to create a multivariate model for every behaviour but this is something that could subsequently be developed.

9.9 Chapter summary

In this Chapter I have presented the follow-up of the women interviewed antenatally and the outcomes of their pregnancies. I have described the prevalence of the antenatal, delivery and postnatal behaviours and I have assessed the relationship between antenatal pregnancy intention (LMUP score) and each behaviour. For every outcome of interest I have examined the relationship between it and each of the antenatal, delivery and postnatal behaviours, as relevant. In the next Chapter I will take these findings forward by developing hierarchical regression models to assess the relationships between antenatal LMUP score and pregnancy outcomes.

Chapter 10 The relationships between pregnancy intention and pregnancy outcomes

In this Chapter I build on the univariate analyses presented in Chapter 9 to examine the relationships between antenatal pregnancy intention and postnatal depression, miscarriage, stillbirth, low birthweight and neonatal death. I develop random effects hierarchical regression models and interpret them for each outcome, discussing the findings. The next Chapter moves on to present the methodology and findings of my qualitative work into postpartum family planning use in Mchinji District.

10.1 Pregnancy intention and composite adverse pregnancy outcome

The univariate logistic regression found no relationship between antenatal LMUP score and the composite adverse pregnancy outcome of miscarriage, stillbirth, low birthweight and neonatal death (OR 1.00 (95%CI 0.98, 1.02)) on univariate analysis and was therefore taken no further.

10.2 Pregnancy intention and postnatal depression

A higher Self-Reporting Questionnaire (SRQ) score indicates a greater likelihood of postnatal depression. The univariate linear regression showed that for every one-point increase in antenatal LMUP score there was a small, but statistically significant, reduction in the postnatal SRQ score of 0.09 points (95%CI -0.11, -0.07). This confirms that the more planned a pregnancy is, the lower the risk of postnatal depression.

I created a hierarchical model, using the conceptual framework (Figure 5-3) to determine the factors at each level and following the steps explained in section 5.5.3, to determine the way in which antenatal LMUP score influences postnatal depression, as measured by the SRQ score. In the first level the factors that have previously been shown to be associated with antenatal LMUP score (Chapter 8) were all added simultaneously, including cluster as a random effect, and were then manually removed in a backwards-stepwise fashion. The factors remaining are shown in SRQ Model 1.

	SRQ Model 1			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Antenatal LMUP score	-0.06	-0.08	-0.04	<0.001
Mother's education level (yrs)	-0.04	-0.07	-0.01	0.006
Previous depression	**Never as baseline**			
- one/two < 2 weeks	0.51	0.29	0.72	
- one ≥ 2 weeks	1.12	0.87	1.36	<0.001
- both ≥ 2 weeks	1.31	0.61	2.00	
IPV - in last year	1.09	0.79	1.40	<0.001
IPV - sexual abuse	1.35	0.78	1.93	<0.001
Number of live children	0.06	0.00	0.12	0.035
Birth interval	**First birth as baseline**			
< 24 months	-0.33	-0.58	-0.08	
2-3 years	-0.31	-0.56	-0.05	0.009
≥ 3 years	-0.38	-0.64	-0.12	
constant	2.81	2.08	3.54	<0.001
sigma_u	1.70			
sigma_e	2.41			
rho	0.33			

SRQ Model 1 Pregnancy intention and postnatal depression with determinants of pregnancy intention

SRQ Model 1 indicates that women with higher levels of maternal education have lower postnatal SRQ scores. Women having their second or subsequent birth have lower postnatal SRQ scores, regardless of the duration of birth interval, than women who are having their first birth. Postnatal SRQ scores are higher in women who have previous possible experiences of depression and women who have been physically or sexually abused. Postnatal SRQ increases as the number of live children increases.

After the inclusion of these variables the direct relationship between antenatal LMUP score and postnatal SRQ was reduced (from -0.09 to -0.06) but was still statistically significant ($p<0.001$). This means that antenatal pregnancy intention has a direct effect on postnatal SRQ score i.e. an effect that is not mediated through the variables associated with antenatal LMUP score.

At the next level of the hierarchy, the antenatal factors associated with postnatal SRQ on univariate analysis at p<0.1 were added. These were months at booking, taking iron/folic acid, IPTp, sleeping under an ITN during pregnancy, VCT, antenatal problems, antenatal SRQ score and miscarriage. VCT and IPTp were excluded but, as shown in SRQ Model 2, the other factors were all significantly associated with postnatal SRQ score and were retained.

	SRQ Model 2			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Antenatal LMUP score	-0.03	-0.06	-0.01	0.001
Mother's education level (yrs)	-0.03	-0.06	-0.01	0.017
Previous depression		**Never as baseline**		
- one/two < 2 weeks	0.25	0.02	0.47	
- one ≥ 2 weeks	0.63	0.38	0.88	<0.001
- both ≥ 2 weeks	0.46	-0.25	1.18	
IPV – in last year	0.73	0.42	1.03	<0.001
IPV – sexual abuse	0.71	0.10	1.32	0.022
Number of live children	0.04	-0.02	0.10	0.153
Birth interval		**First birth as baseline**		
< 24 months	-0.18	-0.43	0.07	
2-3 yrs	-0.19	-0.45	0.07	0.165
≥ 3 yrs	-0.28	-0.54	-0.02	
Months at booking	-0.07	-0.14	0.00	0.036
Took iron/folic acid		**Never as baseline**		
- some days	0.14	-0.28	0.56	<0.001
- every day	-0.27	-0.70	0.15	
Used an ITN during pregnancy		**Never as baseline**		
- some days	-0.22	-0.60	0.16	0.002
- every day	-0.49	-0.79	-0.18	
Antenatal problems	0.75	0.53	0.97	<0.001
Antenatal SRQ score	0.19	0.16	0.21	<0.001
Pregnancy ended in miscarriage	0.72	0.18	1.27	0.009
constant	2.49	1.77	3.21	<0.001
sigma_u	0.73			
sigma_e	2.29			
rho	0.09			

SRQ Model 2 Pregnancy intention and postnatal depression with determinants of pregnancy intention and antenatal behaviour variables

This model tells us that taking iron/folic acid and sleeping under an ITN during pregnancy are associated with lower postnatal SRQ scores. Having antenatal problems, higher antenatal SRQ scores or a miscarriage were associated with higher postnatal SRQ scores. The unexpected univariate finding of lower SRQ scores in women who attend antenatal care later has remained in the multivariate analysis.

After the inclusion of these variables the relationship between antenatal LMUP score and postnatal SRQ score was reduced again (from -0.06 in SRQ model 1 to -0.03) but remained significant (p=0.001). This means that antenatal pregnancy intention has a direct effect on postnatal SRQ score i.e. an effect that is not mediated either through the variables associated with antenatal LMUP score or the antenatal variables.

In this model primiparity / birth interval and the number of live children became non-significant, indicating that their effect on postnatal depression was mediated through the antenatal factors below them in the hierarchy.

The next step was to include the delivery factors that were associated with postnatal SRQ score on univariate analysis at $p<0.1$. These were location and duration of labour, normal delivery, delivery problems, multiple birth, low birthweight and stillbirth. Clean delivery had been excluded *a priori* given its high level of missing data and lack of a robust hypothesis to include it. The coefficients presented for delivery are based on information from women who did not have a miscarriage (see analytical approach in section 5.1.4). Only low birthweight was removed; the significant associations between postnatal SRQ score and the other factors are shown in SRQ Model 3.

In this model experience of sexual abuse became non-significant, indicating that its effect on postnatal depression was mediated through the factors below it in the hierarchy.

	SRQ Model 3			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Antenatal LMUP score	-0.03	-0.05	-0.01	0.015
Mother's education level (yrs)	-0.05	-0.08	-0.02	0.002
Previous depression		**Never as baseline**		
- one/two < 2 weeks	0.21	-0.04	0.45	
- one ≥ 2 weeks	0.59	0.31	0.86	<0.001
- both ≥ 2 weeks	0.32	-0.48	1.12	
IPV - in last year	0.53	0.19	0.87	0.002
IPV - sexual abuse	0.32	-0.32	0.96	0.329
Number of live children	0.05	-0.02	0.11	0.173
Birth interval		**First birth as baseline**		
< 24 months	-0.04	-0.32	0.24	
2-3 yrs	-0.06	-0.35	0.23	0.788
≥ 3 yrs	-0.26	-0.55	0.03	
Months at booking	-0.21	-0.28	-0.14	<0.001
Took iron/folic acid		**Never as baseline**		
- some days	0.19	-0.27	0.66	<0.001
- every day	-0.86	-1.32	-0.39	
Used an ITN		**Never as baseline**		
- some days	-0.59	-1.00	-0.18	0.012
- every day	-0.26	-0.59	0.08	
Antenatal problems	0.38	0.15	0.60	0.001
Antenatal SRQ score	0.25	0.23	0.28	<0.001
Pregnancy ended in miscarriage	1.20	0.58	1.81	<0.001
Delivery location		**Health centre as baseline**		
- In transit	-0.17	-0.96	0.62	
- Home	0.18	-0.26	0.62	<0.001
- MDH	0.52	0.33	0.72	
- Other	0.24	-0.44	0.92	
Duration of labour		**≤ 6 hours as baseline**		
- 7-12 hrs	0.40	0.20	0.60	
- 13-18 hrs	0.42	0.12	0.72	<0.001
- 19-24 hrs	-0.14	-0.52	0.24	
> 24 hours	0.30	-0.12	0.72	
Normal delivery	-0.74	-1.14	-0.34	<0.001
Delivery problems	0.51	0.19	0.83	0.002
Multiple birth	0.71	0.02	1.39	0.043
Pregnancy ended in stillbirth	1.56	0.82	2.31	<0.001
constant	4.53	3.54	5.52	<0.001
sigma_u	0.00			
sigma_e	2.26			
rho	0.00			

SRQ Model 3 Pregnancy intention and postnatal depression with determinants of pregnancy intention and antenatal and delivery behaviour variables

In general, delivering somewhere other than your local health facility, having longer duration of labour, not having a normal delivery, having delivery problems, a multiple birth or stillbirth were all associated with an increase in the postnatal SRQ score. The relationship between antenatal LMUP score and postnatal SRQ score was marginally reduced again (from -0.0347 to -0.0285) but was still significant (p=0.015). This means that some of the effect of antenatal pregnancy intention on postnatal SRQ score is mediated through its effect on the variables associated with antenatal LMUP score and the antenatal and delivery variables but a direct effect remains.

Finally postnatal factors that were associated with postnatal SRQ score on univariate analysis at p<0.1 were added to the model. These were postnatal problems for the woman or baby, attending the postnatal check and initiation of breastfeeding. The coefficients presented for postnatal factors relating to the baby are based on information from women who did not have a miscarriage or stillbirth (see analytical approach in section 5.1.4). Attending the postnatal check was removed but the other factors were significant, as shown in SRQ Model 4. All the factors that were significant in SRQ Model 3 remained significant.

This model tells us that either the woman or the baby experiencing postnatal problems was associated with higher postnatal SRQ scores. Later initiation of breastfeeding remained associated with lower postnatal SRQ scores, as per the unexpected univariate finding.

		SRQ Model 4		
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Antenatal LMUP score	-0.03	-0.05	-0.01	0.014
Mother's education level (yrs)	-0.05	-0.08	-0.02	0.002
Previous depression		**Never as baseline**		
- one/two < 2 weeks	0.22	-0.02	0.46	
- one ≥ 2 weeks	0.61	0.33	0.88	<0.001
- both ≥ 2 weeks	0.42	-0.38	1.21	
IPV - in last year	0.48	0.14	0.82	0.006
IPV - sexual abuse	0.29	-0.35	0.93	0.380
Number of live children	0.04	-0.03	0.10	0.267
Months at booking	-0.21	-0.28	-0.14	<0.001

	SRQ Model 4 cont.			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Birth interval	**First birth as baseline**			
< 24 months	-0.04	-0.32	0.24	
- 2-3 years	-0.06	-0.35	0.22	0.783
≥ 3 years	-0.21	-0.50	0.08	
Took iron/folic acid	**Never as baseline**			
- some days	0.14	-0.33	0.61	<0.001
- every day	-0.91	-1.37	-0.44	
Used an ITN	**Never as baseline**			
- some days	-0.50	-0.91	-0.09	0.036
- every day	-0.21	-0.54	0.13	
Antenatal problems	0.29	0.06	0.52	0.014
Antenatal SRQ score	0.24	0.22	0.27	<0.001
Pregnancy ended in miscarriage	1.20	0.57	1.83	<0.001
Delivery location	**Health centre as baseline**			
- In transit	-0.17	-0.95	0.62	
- Home	0.15	-0.29	0.59	<0.001
- MDH	0.48	0.29	0.68	
- Other	0.27	-0.40	0.95	
Duration of labour	**≤ 6 hours as baseline**			
- 7-12 hrs	0.35	0.15	0.55	
- 13-18 hrs	0.43	0.13	0.73	<0.001
- 19-24 hrs	-0.23	-0.61	0.15	
> 24 hrs	0.27	-0.15	0.69	
Normal delivery	-0.75	-1.15	-0.34	<0.001
Delivery problems	0.47	0.15	0.79	0.004
Multiple birth	0.80	0.11	1.48	0.023
Pregnancy ended in stillbirth	1.37	0.61	2.13	<0.001
Initiation of breastfeeding	**≤10mins as baseline**			
> 10- ≤ 20mins	-0.19	-0.44	0.06	
> 20- ≤ 30mins	-0.26	-0.49	-0.03	0.027
> 30- ≤ 60mins	-0.44	-0.72	-0.17	
> 60mins	-0.13	-0.65	0.39	
Maternal postnatal problems	0.85	0.56	1.15	<0.001
Baby postnatal problems	0.32	0.15	0.50	<0.001
constant	4.56	3.57	5.55	<0.001
sigma_u	0.00			
sigma_e	2.24			
rho	0.00			

SRQ Model 4 Pregnancy intention and postnatal depression with determinants of pregnancy intention and antenatal, delivery and postnatal behaviour variables

10.2.1 Summary of findings for pregnancy intention and postnatal depression

Having included all the determinants of pregnancy intention and antenatal, delivery and postnatal factors known to be associated with postnatal SRQ score, antenatal LMUP still has a small but statistically significant effect on postnatal SRQ score (-0.03, 95%CI -0.05, -0.01, p=0.014). This is a direct effect, i.e. the effect of pregnancy intention on postnatal depression that is not mediated through the effect of pregnancy intention on any of the other variables in the model. It means that for every one-point increase in antenatal LMUP score there is a 0.03-point decrease in postnatal SRQ score, having taken the other variables into account. This confirms that more planned pregnancies are associated with less postnatal depression.

Table 10-1 shows each variable's effect size estimate at the point of entry to the model. This gives the direct effect of each variable on postnatal SRQ score having controlled for the variables higher in the hierarchy.

	Direct effects model			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Antenatal LMUP score	-0.09	-0.11	-0.07	<0.001
Mother's education level (yrs)	-0.04	-0.07	-0.01	0.006
Previous depression		**Never as baseline**		
- one/two < 2 weeks	0.51	0.29	0.72	
- one ≥ 2 weeks	1.12	0.87	1.36	<0.001
- both ≥ 2 weeks	1.31	0.61	2.00	
IPV - in last year	1.09	0.79	1.40	<0.001
IPV - sexual abuse	1.35	0.78	1.93	<0.001
Number of live children	0.06	0.00	0.12	0.035
Birth interval		**First birth as baseline**		
< 24 months	-0.33	-0.58	-0.08	
- 2-3 years	-0.31	-0.56	-0.05	0.009
≥ 3 years	-0.38	-0.64	-0.12	
Months at booking	-0.07	-0.14	0.00	0.036
Took iron/folic acid		**Never as baseline**		
- some days	0.14	-0.28	0.56	<0.001
- every day	-0.27	-0.70	0.15	

	Direct effects model cont.			
Postnatal SRQ score	**β coeff.**	**95%CI**		**p-value**
Slept under an ITN	**Never as baseline**			
- some days	-0.22	-0.60	0.16	0.002
- every day	-0.49	-0.79	-0.18	
Antenatal problems	0.75	0.53	0.97	<0.001
Antenatal SRQ score	0.19	0.16	0.21	<0.001
Pregnancy ended in miscarriage	0.72	0.18	1.27	0.009
Delivery location	**Health centre as baseline**			
- In transit	-0.17	-0.96	0.62	<0.001
- Home	0.18	-0.26	0.62	
- MDH	0.52	0.33	0.72	
- Other	0.24	-0.44	0.92	
Duration of labour	**≤ 6 hours as baseline**			
- 7-12 hrs	0.40	0.20	0.60	<0.001
- 13-18 hrs	0.42	0.12	0.72	
- 19-24 hrs	-0.14	-0.52	0.24	
> 24 hrs	0.30	-0.12	0.72	
Normal delivery	-0.74	-1.14	-0.34	<0.001
Delivery problems	0.51	0.19	0.83	<0.001
Multiple birth	0.71	0.02	1.39	0.043
Pregnancy ended in stillbirth	1.56	0.82	2.31	<0.001
Maternal postnatal problems	0.85	0.56	1.15	<0.001
Baby postnatal problems	0.32	0.15	0.50	<0.001
Initiation of breastfeeding	**≤10mins as baseline**			
> 10 - ≤ 20mins	-0.19	-0.44	0.06	0.027
> 20 - ≤ 30mins	-0.26	-0.49	-0.03	
> 30 - ≤ 60mins	-0.44	-0.72	-0.17	
> 60mins	-0.13	-0.65	0.39	

Table 10-1 Direct effect of each variable on postnatal SRQ score, having controlled for variables higher in the hierarchy

According to these data, stillbirth was the variable that made the biggest difference to postnatal SRQ score, increasing it by 1.56 points (95%CI 0.82, 2.31). Ever experience of sexual abuse (1.35 95%CI 0.78, 1.93) or physical abuse in the last year (1.09 95%CI 0.79, 1.40) had the next-greatest effects. Antenatal, delivery or postnatal problems, not having a normal delivery or having a miscarriage or a multiple birth all have effect sizes in the range of 0.70 – 0.88 points.

In contrast to these, the effect of pregnancy intention might seem very modest, as even its unadjusted effect size was -0.09 points (95%CI -0.11, -0.07). However, it should be remembered that this is the estimated effect size for a one-point increase in LMUP score. It is not an estimate of the effect of an unintended versus an intended pregnancy. Therefore the difference between a pregnancy with an LMUP score of 12 (highly planned) and zero (highly unplanned) would be twelve times this effect size, or -1.06 (95%CI -1.32, -0.84) points on the postnatal SRQ score (unadjusted). The equivalent direct effect (i.e. the effect not mediated by the effect of pregnancy intention on other variables in the model) would be -0.34 (95%CI -0.07, -0.62) points on the postnatal SRQ score. In the context of the distribution of the postnatal SRQ score (shown in Figure 9-4), where 75% of women had a score between zero and three, these effect sizes are important. Therefore pregnancy intention is a significant risk factor for postnatal depression, even once its effect on other variables that also influence postnatal depression is taken into account.

10.2.2 Determinants of postnatal depression

In addition to the interpretation of these models for the relationship between pregnancy intention and postnatal SRQ score, we can see which other factors were associated with postnatal maternal mental health problems and compare this with the literature presented in section 3.3.3.6.

The postnatal SRQ score was increased in women who had had previous possible episodes of depression or who had higher antenatal SRQ scores (indicating antenatal depression), as others had found (63, 122, 216, 220-228). It was also increased in women who had ever experienced sexual abuse or who reported physical abuse in the last year, in keeping with other literature (205, 306, 307).

As other studies showed (201, 216), women who experienced a miscarriage or stillbirth were more likely to be depressed postnatally; surprisingly neonatal death was not significant in these data, perhaps as there were only 90 deaths. In keeping with other studies, women who experienced antenatal (215), delivery or postnatal problems (201), who did not have a normal

delivery (201) and mothers of babies who had postnatal problems (194, 215) also had higher postnatal SRQ scores. Each one-year increase in the mother's education level was associated with a reduction in her postnatal SRQ score (184). Taking iron/folic acid or sleeping under an ITN regularly during pregnancy were associated with lower postnatal SRQ scores, the mechanism of effect for this may be by reducing or preventing maternal anaemia (229).

Factors that had not previously been noted to be associated with postnatal depression in the literature were: primiparity, number of live children, delivering somewhere other than the local health centre or longer duration of labour. Childcare stress was noted in the high-income country data (180) and may be related to the number of children a woman has. I found that each additional child the woman had increased the postnatal score slightly, which has not previously been reported, however this effect was mediated by other factors in the hierarchy.

This information can be used in two main ways. Firstly, the knowledge of which women are at higher risk of postnatal depression, such as those experiencing an unintended pregnancy, miscarriage, stillbirth, multiple birth or problems during pregnancy, delivery or the postnatal period, can be identified and offered additional support. Secondly, practices that are shown to reduce postnatal SRQ scores, such as iron/folic acid consumption in pregnancy, should be promoted.

10.3 Pregnancy intention and individual adverse pregnancy outcomes

The composite measure of adverse pregnancy outcome (miscarriage, stillbirth, low birthweight and neonatal death) did not show any relationship between pregnancy intention and pregnancy outcome. 18.0% of pregnancies resulted in an adverse outcome; low birthweight was by far the most common (72.1%) and would drive the results of the analysis of the composite outcome. Therefore, I assessed the relationships between pregnancy intention and each adverse outcome individually, though these analyses are underpowered.

10.3.1 Pregnancy intention and miscarriage

I used logistic regression to assess the relationship between antenatal LMUP score and miscarriage and found no relationship (OR 1.01 (95%CI 0.96, 1.06)).

10.3.2 Pregnancy intention and stillbirth

There was a borderline significant relationship between antenatal LMUP score and stillbirth on univariate logistic regression (OR 0.94 (95%CI 0.89, 1.00) p=0.056). This suggests that the more planned a pregnancy is, the lower the risk of stillbirth. Although this finding was only of borderline significance I decided to continue to the multivariate model as an exploratory, hypothesis generating analysis.

To determine the way in which antenatal LMUP score influences stillbirth I created a hierarchical model in the same way as that for postnatal depression but using random effects logistic regression. In the first level the factors that had previously been shown to be associated with antenatal LMUP score were added, including cluster as a random effect, and then removed in a manual backwards-stepwise fashion. The only factor to remain in the model at p<0.1 was primiparity / birth interval, as shown in Stillbirth Model 1. This shows that women who were not having their first birth had lower odds of having a stillbirth, regardless of the duration of the birth interval.

	Stillbirth Model 1			
Stillbirth	**OR**	**95%CI**		**p-value**
Antenatal LMUP score	0.94	0.88	1.00	0.039
Birth interval	**First birth as baseline**			
< 24 months	0.52	0.26	1.03	
- 2-3 yrs	0.58	0.29	1.16	0.060
≥ 3 yrs	0.56	0.29	1.08	
constant	0.04	0.02	0.07	<0.001
sigma_u	0.45	0.20	1.01	
rho	0.06	0.01	0.24	0.047

Stillbirth Model 1 Pregnancy intention and stillbirth with determinants of pregnancy intention

After the inclusion of this variable the effect size for the relationship between antenatal LMUP score and stillbirth was unchanged but more statistically significant (p=0.039). This means that antenatal pregnancy intention has an effect on the odds of stillbirth that is not mediated through birth interval / primiparity.

At the next level of the hierarchy the antenatal factors associated with stillbirth on univariate analysis at p<0.1 were added. These were attendance at ANC, antenatal problems and antenatal SRQ score. Antenatal SRQ score was not significant and was excluded; Stillbirth Model 2 shows the associations of the other variables with stillbirth. Having attended antenatal care was associated with lower odds of having a stillbirth and having had antenatal problems more than doubled the odds of stillbirth. Primiparity / birth interval remained statistically significant.

	Stillbirth Model 2			
Stillbirth	**OR**	**95%CI**		**p-value**
Antenatal LMUP score	0.94	0.89	1.01	0.077
Birth interval	**First birth as baseline**			
< 24 months	0.50	0.25	0.99	
- 2-3 yrs	0.55	0.27	1.12	0.047
≥ 3 yrs	0.50	0.26	0.98	
Attended antenatal care	0.10	0.03	0.36	0.001
Antenatal problems	2.32	1.34	4.00	0.002
constant	0.29	0.07	1.16	0.080
sigma_u	0.41	0.16	1.02	
rho	0.05	0.01	0.24	0.084

Stillbirth Model 2 Pregnancy intention and stillbirth with determinants of pregnancy intention and antenatal behaviours

After the inclusion of these variables the effect size of antenatal LMUP score on stillbirth was unchanged but has returned to borderline significance at p=0.077. This could mean that the effect of antenatal pregnancy intention is mediated through its effect on these antenatal variables or that the analysis has lost power as there are only 66 stillbirths.

Delivery factors associated with stillbirth at p<0.1 on the univariate analysis were added to the model to assess whether this further explained the effect

of pregnancy intention on the odds of stillbirth. These were delivery location and duration, transfers in labour, normal delivery, delivery problems, multiple birth and gender. The odds ratios presented for delivery factors are based on information from women who did not have a miscarriage (see analytical approach in section 5.1.4). The results of this model are shown in Stillbirth Model 3.

	Stillbirth Model 3			
Stillbirth	**OR**	**95%CI**		**p-value**
Antenatal LMUP score	0.94	0.88	1.00	0.068
Birth interval	**First birth as baseline**			
< 24 months	0.52	0.24	1.09	
- 2-3 yrs	0.54	0.25	1.17	0.083
≥ 3 yrs	0.51	0.25	1.04	
Attended antenatal care	0.17	0.03	0.98	0.048
Antenatal problems	1.60	0.88	2.93	0.125
Delivery location	**Health centre as baseline**			
- Transit		None		
- Home	2.53	0.82	7.82	0.018
- MDH	2.26	1.19	4.31	
- Other	5.26	1.42	19.5	
Normal delivery	0.47	0.23	0.98	0.043
Delivery problems	2.68	1.37	5.21	0.004
Multiple birth	5.76	2.69	12.4	<0.001
Female baby	0.59	0.35	1.01	0.056
constant	0.18	0.02	1.27	0.086
sigma_u	0.52	0.25	1.08	
rho	0.08	0.02	0.26	0.022

Stillbirth Model 3 Pregnancy intention and stillbirth with determinants of pregnancy intention and antenatal and delivery variables

Experiencing delivery problems was associated with more than two-and-a-half-times the odds of having a stillbirth and multiple births were associated with almost six times the odds of stillbirth. Delivering anywhere other than the local health facility increased the odds of stillbirth, whereas normal deliveries were associated with reduced odds of stillbirth. There is a suggestion that baby girls were less likely to be stillborn than baby boys.

Experiencing antenatal problems has become non-significant in this model, suggesting that its effect is mediated through these delivery variables.

The effect size for the relationship between pregnancy intention and stillbirth remains unchanged at 0.94 and the p-value has come down slightly but is still only of borderline significance (p=0.068). This could mean that the effect of antenatal pregnancy intention is mediated through the variables associated with pregnancy intention and its effect on antenatal and delivery factors or that the analysis has lost power. This potential relationship warrants further investigation.

10.3.2.1 Summary of findings for pregnancy intention and stillbirth

Having included all the determinants of pregnancy intention and antenatal and delivery factors known to be associated with stillbirth, increasing antenatal LMUP was associated with borderline significantly reduced odds of stillbirth (OR 0.94 (95%CI 0.88, 1.00) p=0.068). This is a direct effect i.e. the effect of pregnancy intention on stillbirth that is not mediated through the effect of pregnancy intention on any of the other variables in the model. It suggests that for every one-point increase in antenatal LMUP score there are 0.94 times the odds of stillbirth. Across the range of the LMUP a pregnancy with an LMUP score of 12 (highly planned) would have 0.47 times the odds (95%CI 0.21, 1.06) of having a stillbirth than a pregnancy with an LMUP of zero (highly unplanned).

The estimate of effect size did not change throughout the analysis, however the relationship between pregnancy intention and stillbirth was not always statistically significant and was not significant in the final model. This may be due to a lack of power, given the small number of stillbirths in the analysis, or it may be that there is no relationship between pregnancy intention and stillbirth or that the relationship is mediated through other factors. These data suggest, but do not confirm, that a less planned pregnancy is potentially an important contributory risk factor to stillbirth in low-income countries. To my knowledge only one study has investigated this, where it was found that unplanned pregnancies had about double the risk of 'pregnancy loss' (miscarriage, induced abortion or stillbirth) (130). As my findings were only

of borderline significance this potential relationship should be investigated in larger prospective cohorts.

10.3.2.2 Determinants of stillbirth

In Table 10-2 each variable's effect size estimate at the point of entry to the model is shown. This gives the direct effect of each variable on the odds of having a stillbirth, having controlled for the variables higher in the hierarchy.

	Direct effects model			
Stillbirth	**OR**	**95%CI**		**p-value**
Antenatal LMUP score	0.94	0.89	1.00	0.056
Birth interval	**First birth as baseline**			
< 24 months	0.52	0.26	1.03	
- 2-3 years	0.58	0.29	1.16	0.060
≥ 3 years	0.56	0.29	1.08	
Attended antenatal care	0.10	0.03	0.36	0.001
Antenatal problems	2.32	1.34	4.00	0.002
Delivery location	**Health centre as baseline**			
- Transit		None		
- Home/TBA	2.53	0.82	7.82	0.018
- MDH	2.26	1.19	4.31	
- Other	5.26	1.42	19.5	
Normal delivery	0.47	0.23	0.98	0.043
Delivery problems	2.68	1.37	5.21	0.004
Multiple birth	5.76	2.69	12.4	<0.001
Female baby	0.59	0.35	1.01	0.056

Table 10-2 Direct effect of each variable on the odds of stillbirth, having controlled for variables higher in the hierarchy

This shows which factors other than pregnancy intention were associated with stillbirth. According to these data, having a multiple birth was the variable that increased the odds of stillbirth the most (OR 5.76, 95%CI 2.69, 12.4). Delivery location had the next-greatest effects, with increased risks in women delivering anywhere other than their local health facility. This was followed by antenatal or delivery problems and first births, all of which approximately doubled the odds of stillbirth. Finally, attending antenatal care

was extremely protective, reducing the odds of stillbirth by 0.10 times (95%CI 0.03, 0.36).

As per the risk factors in Table 3-3, the odds of stillbirth were increased in women who were having their first pregnancy or a multiple birth and women who experienced either antenatal or delivery problems. Not having a normal delivery, though not specifically covered in the literature, was also a significant risk factor for stillbirth in these data but is likely to be related to having delivery problems which was mentioned.

Findings not previously mentioned in the literature, and that may be more relevant to low-income countries where women have poorer access to quality antenatal and delivery care, include not attending antenatal care and delivering anywhere other than a health centre. For women delivering at home this may be due to a lack of skilled care; for those at MDH or other hospitals this may be due to the problems or complications that led to them being referred to these tertiary services.

Ensuring that women have access to, and attend, good quality antenatal care can help to detect women who are experiencing problems and are therefore at increased risk of stillbirth. Likewise, encouraging women to deliver in a health facility with a skilled birth attendant and from where they can be referred promptly, if necessary, could also reduce the stillbirth rate.

10.3.3 Pregnancy intention and low birthweight

Univariate logistic regression was used to assess the relationship between antenatal LMUP score and low birthweight using the imputed data. There was no relationship between pregnancy intention and low birthweight (OR 1.00 (95%CI 0.98, 1.03)). This was also true using the birthweight data that had been collected, rather than the imputed data.

10.3.4 Pregnancy intention and neonatal death

There was no relationship between antenatal LMUP score and neonatal death on univariate logistic regression (OR 1.03 (95%CI 0.98, 1.09)).

10.4 Summary of findings for pregnancy intention and pregnancy outcomes

There was no relationship between antenatal pregnancy intention and the composite primary outcome of adverse pregnancy outcome (miscarriage, stillbirth, low birthweight and neonatal death).

Examining the individual components of adverse pregnancy outcome showed no relationships for miscarriage, low birthweight or neonatal death. More planned pregnancies were associated with borderline significantly reduced odds of stillbirth on univariate analysis. Hierarchical analysis revealed that the effect size did not change as the determinants of pregnancy intention, antenatal and delivery factors were added to the model. However the increasing parameterisation of a model containing only 66 stillbirths meant a loss of analytical power meaning this relationship could not be confirmed. This preliminary finding needs to be verified in larger studies.

Less planned pregnancies were associated with an increase in the postnatal SRQ score, indicating greater likelihood of postnatal depression. Some of this relationship was mediated through the determinants of pregnancy intention and factors in the antenatal, delivery and postnatal periods but a small direct effect of pregnancy intention on postnatal depression remained.

10.5 Chapter summary

In this Chapter I have described the findings of the multivariate hierarchical regression analysis of the relationships between antenatal pregnancy intention and maternal and neonatal pregnancy outcomes. The next Chapter, the final Chapter in Section II, describes the qualitative work undertaken to explore the attitudes of men and women to postpartum family planning.

Chapter 11 Postpartum family planning

This is the final Chapter of Section II, the 'Results' Section. In it I present the rationale for my decision to explore the issues around postpartum family planning in Mchinji District as the focus of my qualitative work. I describe the methodology and present the findings of the focus group discussions that I conducted on this topic. The next Chapter, in Section III, is the final Chapter, bringing together the findings from across the thesis to draw conclusions and make recommendations.

11.1 Background

The hierarchical analysis of the factors associated with pregnancy intention showed that women who had experienced an unplanned pregnancy fell into three groups (section 8.5). Firstly, women who tended to be younger, unmarried and having their first child, secondly, women who tended to be older and married but who were either having a pregnancy within two years of their last pregnancy or who already had all the children they wanted and, thirdly, women who had experienced depression or intimate partner violence in the last year.

The second group of women, those with rapid, repeat pregnancies or a pregnancy when they already had their desired number of children, could have avoided these unintended pregnancies had they been able to access effective family planning after their last pregnancy.

Closely spaced pregnancies are risky for both mother and baby, leading to increased risk of maternal death, miscarriage, stillbirth, low birthweight, preterm birth and child mortality (4, 16, 357-359). The most recent estimates suggest that the risk of death in the first year of life would fall by 10%, and by 21% in years one to four, if all children in developing countries were spaced by a gap of two years (4). A further 30% of maternal deaths could be also be averted. Pregnancy, delivery and the postnatal period are associated with frequent health service contacts for women and thus provide many opportunities for discussing PPFP and birth spacing. Despite this, data from

the DHS in 27 countries showed that while 95% of women who were within 12 months of giving birth wished to avoid another pregnancy in the next 24 months, only 30% of them were using contraception (360). Interim analysis of the data being collected in my research showed low uptake of postpartum family planning (PPFP) in the women in the cohort (only 28.9% were using a modern method of contraception). I therefore decided to explore the attitudes to PPFP in men and women to try to understand the reasons behind the low uptake despite the evident and expressed need.

Studies based on DHS-style data show that African women tend to rely on traditional methods of birth spacing: postpartum amenorrhoea (extended by exclusive breastfeeding) and postpartum abstinence (361, 362). In West Africa this can provide a good degree of protection, at least for the first year, as in Burkina Faso, for example, women are insusceptible to pregnancy for a median of 15.0 months due to the combination of duration of breastfeeding, postpartum amenorrhoea and abstinence (363). In Malawi practices are not so protective. According to the 2010 DHS, the median duration of postpartum abstinence in the Central Region (where Mchinji District is located) is 3.1 months, and menses will have returned for half of all women by 11 months (22). Women may use traditional medicines to try to prevent pregnancy.

Without PPFP it is possible for women who are not breastfeeding to become pregnant again within 45 days of delivery (364) and if women are not exclusively breastfeeding pregnancy can occur before menses resume. However, in many countries women will not start contraception until their menstrual period has returned, incorrectly believing that they are completely protected until then (361, 365). Non-peer-reviewed data from studies in four countries by the PROGRESS project[xxx] also found that health care providers would sometimes refuse to provide women contraception until their menses had resumed or would require them to pay for a pregnancy test first (365); this was also found in Burkina Faso (363). Provision is further hampered by

[xxx] PROGRESS (Program Research for Strengthening Services) was a five-year project awarded to FHI 360 by the U.S. Agency for International Development that sought to improve access to family planning among underserved populations.

the fact that policy often only requires a discussion of family planning once in the first six-weeks after delivery but many women miss this counselling as they do not attend health services during this time (365). Considerable supply side factors to improving the uptake of PPFP were highlighted in Ethiopia and Kenya, such as problems with commodity supply and management, lack of training (particularly around intrauterine device (IUD) insertion) and the challenges of providing PPFP services to women who do not deliver in a health facility (366).

There have been a few quantitative studies investigating the determinants of intention to use PPFP. A recent survey in Ghana investigating factors influencing the intention to use PPFP in pregnant women found that about 70% intended to use it (367). Intention was associated with knowledge of methods, whether she considered PPFP to be acceptable and whether she perceived her partner to find PPFP acceptable (367). A Nigerian study found that 54% of pregnant women intended to use PPFP and that intention was associated with age, parity, education and having received counselling about contraception (368). These studies were both limited by the fact that women were not followed up after delivery to see how well these intentions translated into uptake and, as discussed in section 2.2.5.1, there are many factors other than intention that influence behaviour.

PPFP would generally be discussed and started during routine postnatal care. Postnatal care is critical for both mother and baby and has been recognised as a major gap in the continuum of care (369); in the Malawi 2010 DHS only 52.4% of women reported having had a postnatal check (22). In Lilongwe District a study in 2012-3 found that 56.6% of women attended postnatal care within six-weeks of delivery. Stepwise multivariate logistic regression showed that utilisation of an alternative source of care, women's perception of healthcare worker's performance, health education, place of delivery, SES and the occurrence of complications during delivery were significantly associated with the utilisation of postnatal care (370). Reported attendance at the postnatal check was higher in my data (79.5%) than either

this study or the DHs data but there is still a significant portion of women who are missed.

These quantitative studies tell us something about the determinants of intention to use PPFP and postnatal care, but do not give us much information about how or why women make these decisions. Qualitative research, which is better suited to answering these questions, is lacking on this topic, particularly in sub-Saharan Africa. Interviews with women and men in Burkina Faso uncovered a range of influences on PPFP uptake in addition to those already mentioned. These included concerns about the side effects of contraception, often particularly from women's partners, and disagreement with partners about resumption of sexual relations where men wanted to have sex sooner than the women and women were worried that if they did not agree their partner would leave them or be unfaithful (363). Further qualitative data in this area seems to be lacking but is sorely needed in order to design strategies and plan services to increase the uptake of PPFP and avoid this missed opportunity.

11.2 Methods

To investigate how and why women and their partners decide to use PPFP I chose to conduct a series of focus groups with men and women. They had to be separate groups given the existing power relations; it would have been impossible for women to freely express their views on an issue of this nature in a group discussion involving men. I chose focus group discussions rather than in-depth interviews as I felt that this format would be a less threatening situation for the women and because I wanted to explore the group social norms around this issue, not just individual opinions.

11.2.1 Selection of areas for focus group discussions

I planned focus group discussions (FGDs) in two different areas: Mbewa and Matimba. These two areas were a purposive sample,[xxxi] chosen because they had different characteristics (such as average socio-economic score

[xxxi] The aim of this sampling technique is not to select a representative population but to choose a sample with the range of characteristics that will best enable me to answer my research questions.

and distance to health facility) and different patterns of attendance at postnatal checks, which are factors that may influence uptake of PPFP. Women who had attended a postnatal check were more likely to be using PPFP and therefore including women who had and had not attended the postnatal check in FGDs was important so that I could explore the reasons behind this.

In Mbewa most women said at the postnatal interview that they had attended for a postnatal check. As Mbewa was a cluster with a high number of respondents there were also sufficient women who said that they had not attended a postnatal check to have a separate FGD with them. The rationale behind this was that I thought women would feel more comfortable discussing the reasons why they had not attended with other women who had also not attended, rather than in a group where the dominant discourse was one of attending the postnatal check. Two other groups were conducted in Mbewa: one with women who had attended for a postnatal check and one with men. Two groups were conducted in Matimba: one with women and one with men. In Matimba there was a much more even split between whether the woman had attended a postnatal check or not, making a group who were mixed on this characteristic feasible as there should be no dominant discourse that would prevent some members of the group expressing their opinions. I planned five FGDs in total with the option to conduct more if there were concerns that saturation had not been reached.

11.2.2 Recruitment of participants

Before recruiting FGD participants, the project supervisors met the local village chiefs in the areas where we were planning to conduct the FGDs. The purpose of the FGDs was explained and permission sought from the village chiefs to invite men and women to participate. Once this permission was secured, men and women were recruited in different ways. The village chief helped to identify men in the area whose partners had had a baby within the last year; this was the only inclusion criterion for men. I identified women in each area who were part of the research cohort on the relationships between pregnancy intention and pregnancy outcomes. A

shortlist of women of a range of ages, from a mixture of villages, with a variety of previous and current contraceptive histories, stratified by whether they had attended the postnatal check, was given to the project supervisors to recruit from. The aim of this purposive sampling was to capture the full range of views and experiences. The supervisors visited the men and women at home a few days before the FGD, explained the purpose of the meeting and invited them to participate, giving them details of the time and place that the discussion would be held. Up to 12 men or women were invited per focus group with the hope that 8-10 would attend.

11.2.3 Development of topic guide

I drafted the topic guide to explore attitudes to postpartum family planning and the postnatal check on the basis of the literature discussed above and the questions that I was hoping to answer. This was shared with all the FGD facilitators in advance for discussion. All four facilitators (my three project supervisors plus a MaiMwana employee) attended a one-day meeting that I facilitated discussing the purpose of the FGDs, how to be a good facilitator and going over the topic guide together. At this meeting we agreed the content and the translation of the topic guide (see Appendix Y).

11.2.4 Conduct of FGDs

All facilitators had had previous experience of conducting FGDs. The men's FGDs were facilitated by one of my three project supervisors (male) with a second (also male) supporting and taking notes. A female MaiMwana staff member facilitated two of the three women's FGDs with a project supervisor (male) supporting and taking notes. A male project supervisor facilitated the third female FGD with a second male project supervisor supporting and taking notes. Although it would have been preferable to have all the women's FGDs led by the female facilitator due to cultural sensitivities, this was not possible due to her other work commitments. At the start of the single women's FGD facilitated by a man we had some extra discussions to try to help the women feel at ease discussing matters of family planning with a male facilitator, pointing out that the male facilitators were healthcare

workers, and also parents, so the women could feel free to speak their opinions.

The focus groups were held in a room in a local school or church, were conducted in Chichewa and lasted around 1.5 hours. I observed every FGD. At the start of the meeting the purpose of the FGD was explained again and there was time for questions before each person gave written consent to participate and for the discussion to be recorded. Each participant was given a number and was asked to say this number every time they spoke. This was so that the transcriber would know who was speaking whilst retaining the anonymity of participants. I recorded the discussions digitally on my Dictaphone and on my laptop. Refreshments were provided at the end of the discussion and all participants were given 1,000 Malawi Kwacha (~£1.44) to compensate them for their travel expenses. I had a debriefing meeting with the facilitators immediately after each FGD to clarify what was discussed during the meeting and explore any issues or clarifications needed in the topic guide.

11.2.5 Transcription and translation

The facilitator of each FGD transcribed the FGD in Chichewa, using both digital recordings and their notes from the meeting to ensure as complete a transcript as possible. The project supervisor who had been present in support translated these transcriptions and sent them back to the facilitator for verification. The first two FGDs were conducted in the week commencing 5th May 2014 and were transcribed and translated within a week. I reviewed these transcriptions and translations; where I identified omissions (Chichewa in the audio recording that I could not see on the transcription) I highlighted these and sent them back to the transcriber to be corrected. If there were translations that were not clear to me then I discussed these with the translator and transcriber.

Prior to conducting the next three focus groups I met with all the facilitators to give feedback on the FGDs, transcriptions and translations and to identify areas of the topic guide where the data were thinner from the first two FGDs and needed focusing on in the next FGDs. These FGDs were conducted in

the week of 26th May 2014 and were translated within 10 days. I went through the same process of reviewing the translations and transcriptions and discussing these with the relevant facilitators. Finally I met with all three project supervisors together to go through the translation of every focus group, line by line, to confirm that we were all in agreement with the transcription and translation, that I understood the translation and that saturation had been reached.

11.2.6 Analysis

I uploaded the English translations of the FGDs to Nvivo 10 and analysed them using a Framework analysis approach. Framework analysis was developed at the National Centre for Social Research in the 1980s (371) and is now widely used, particularly in policy relevant research. It takes a five-step approach to managing and interpreting the data, which I followed. I chose this methodology as the aim of these FGDs was to answer pre-defined questions about PPFP rather than to generate theory, where an approach such as grounded theory would be more appropriate. The unit of analysis was the focus group, not the individuals within the groups.

Having familiarised myself with the data through the translation process, discussion with the facilitators and subsequent re-reading of the transcripts (stage one), I developed the thematic framework (see Appendix Z) from the topic guide, my knowledge of the area and previous literature (stage 2). I applied this framework to all five FGDs (stage 3) with emergent codes added during the analysis. Using Nvivo I created a set of framework matrices, with one matrix per theme from the thematic framework. In these matrices each FGD is a row and the components of each theme form the columns. I summarised the data into these matrices (stage 4), which I then interpreted to answer the following questions (stage 5):

- Do women and men wish to limit the number of children they have or space their births? If so, why?
- Are there differences between men and women in the desired number / spacing or reasons given?

- Why do couples succeed or fail to space / limit births?
- Why do women go, or not go, for the one-week postnatal check?
- How do men and women feel about starting and using family planning after the birth of a child?

These findings were then used to answer the question: How could the uptake of PPFP be improved in Mchinji District?

11.3 Results

Five FGDs were conducted, as planned. All the FGDs had 9-10 participants apart from the men's FGD in Mbewa that had five. Women's ages ranged from 17 to 44 and men's from 22-47. Participants had between zero and six children (zero being due to child loss). Most but not all participants had used a modern method of family planning at some point during their lifetime.

Where individuals have been quoted I have referred to them by the focus group and their participant number, for example 'Matimba_FGD2_male_P7'.

11.3.1 Desire for spacing and limiting

This section uses the FGDs to try to answer the first four questions: Do women and men wish to limit the number of children they have or space their births? If so, why? Are there differences between men and women in the desired number / spacing or reasons given? Why do couples succeed or fail to space / limit births?

11.3.1.1 Do women and men wish to limit the number of children they have or space their births?

Some have argued that in African settings that are 'traditional' (i.e. pre-demographic transition, as discussed in section 2.2.3), women and men do not think about how many children they would like to have and how far apart or they think that these decisions are up to God e.g. (51, 84). However, these views were not apparent in these FGDs. Most men and women talked about a desire to space the births of their children and to stop childbearing after a certain number; only one person said '*I have never programmed myself on how many children to have in my lifetime; I have no means that I*

can plan to have children the way I wanted' (Matimba_FGD2_male_P7). On the influence of religion, and the idea of children being gifts from God, one male participant talked about how his own thinking on this had evolved. He said that he had previously thought that '*it is God who does family planning'* but that he now saw that in holding this view he was *'a very behind person'* and that God has helped him to understand that family planning is *'very very important and that's what is helping us with our children and you feel very proud'* (Mbewa_FGD3_male_P1).

11.3.1.2 Are there differences between men and women in the desired number / spacing or reasons given?

There was considerable similarity in how many children men and women said they would ideally like. Women wanted between three and six children, with the most frequent response being three but the median being four. Men wanted between two and six children, with both the most frequent response and the median being four. Additionally most women and men wanted five years between births.

Despite the similarity expressed separately in the FGDs, both men and women thought that the other wanted more children than them. There seemed to be two main reasons for this. Firstly, both women and men talked about the **difficulty of discussing** contraception and number of children, even between husband and wife. Some said that they simply did not discuss these things and that the woman would be afraid to bring up the issue of family planning as, traditionally, women cannot dictate to their husbands about such issues. Where discussions did happen, a few women said that they had agreed a number with their husband and had now had tubal ligation. Other women said that they have to agree with whatever number their husbands decide and that if the husband wants more children then '*it is impossible for me to stop having children*' (Mbewa_FGD2_female_P10). In contrast, women in two FGDs said that they went to get contraception without their husband's knowledge as their husbands were against it. In talking about this they both used a Chichewa proverb: '*Your bag of life*

cannot be kept by someone else' essentially meaning that you have to take care of yourself.

Conversely there were some women who knew how many children their partner wanted and said that they wanted more children than their husbands did. The general impression in the male FGDs was that '*the woman needs more children while the man needs fewer children'* (Matimba_FGD2_male_P3). One male participant suggested this was because women thought that they needed to have more children to replace any that die, but no women mentioned this. Men suggested that men were seen as to blame when the method of contraception failed because it was the method that the man had agreed to. They thought that women interpreted this as a deliberate act taken because the man wanted more children than they had said. Both men and women talked extensively about getting pregnant despite using family planning methods. Men in the Matimba FGD said *'we have the need to have few children, only that we fail'* (Matimba_FGD2_male_P3) and '*we fail because we disregard family planning'* (Matimba_FGD2_male_P1).

The second reason for the perceived differences between men and women with regard to the number of children to have was a **lack of certainty** in the permanence of the current relationship. This issue only came out in the male FGDs. Men thought that women were concerned that they would need to be able to bear children in order to secure another relationship if their partner left them, or that their partner would leave them if they could not have more children. One participant said '*yet men don't think like that'* (Mbewa_FGD3_male_P3) but this was contradicted by another saying '*despite taking our self as a respectable man'* and agreeing on the number of children and for the women to have tubal ligation, some men do then look for another woman (Mbewa_FGD3_male_P1). He thought that this was causing women to refuse to have tubal ligation, forcing reliance on less effective methods and resulting in unintended pregnancies. This was not mentioned in any of the female FGDs; indeed some women had already had tubal

ligation since their last pregnancy and several were planning to have it done in the near future.

Men thought that both women and men were afraid to be honest about wanting fewer children, each thinking that the other would leave them for someone who wanted more children: '*we do accept the children just to prevent the wife from going and marrying someone else'* (Mbewa_FGD3_male_P4).

It may be, therefore, that there is not actually much of a difference in opinion between men and women on the number of children to have. Instead, the lack of discussion and the inability to be honest about your own preferences leads to misunderstandings, with both parties thinking that the other wants more children than they actually do. This belief may be because a higher number of children were wanted in the past '*the number of children families have is dwindling… in the past a couple could have 10 or 11 children'* (Mbewa_FGD3_male_P4) and it is taking some time for the '*modern family size'* (Mbewa_FGD3_male_P1) to be assimilated. It is also compounded by pregnancies that are seen to occur despite using contraception and that are assumed to be because the other person wants more children than they admitted to, or are because of using less effective methods owing to a resistance to terminal methods of family planning due to uncertainty about the future and the duration of the relationship.

11.3.1.3 Why do couples want to space / limit births?

Although women and men shared some common ground in the reasons they gave for wanting to either space births or limit the number of children they have, there were also some considerable differences. The reasons given for limiting the number of children fell into seven themes: caring for the children, managing the household budget, land/farming, poverty, population, women's health and changing norms.

For all the women's groups '*having children based on your ability to take proper care of them'* (Mbewa_FGD1_female_P1) was the dominant theme. By this it was meant that children should grow well, be fed, clothed and sent

to school. Both of the men's groups talked about having '*a number of children that is manageable'* (Mbewa_FGD3_male_P4) but this was more from the perspective of the need to manage the **household budget** rather than **caring for the child**. Men therefore linked unplanned pregnancies and large numbers of children to **poverty**: '*I have had several unplanned pregnancies… it's like we are continuing giving birth and this will result in poverty'* (Matimba_FGD1_male_P6).

For men the dominant themes were **land/farming** and **population**. As subsistence farmers they were concerned about the effects that a shortage of land and unpredictable rain patterns had on their income and therefore on their ability to support their household. If the harvest fails '*you cannot even clothe two children… which is why we say it is not good to have too many children … so I see that it is good to have a limit'* (Mbewa_FGD3_male_P1). The lack of land for cultivation and settlement was seen to be a consequence of over-population; a lack of family planning was said to be causing a '*population boom'* (Matimba_FGD2_male_P6).

Women's health was raised by one of the women's groups and one of the men's groups with relation to the number of children, but was more relevant to discussions about spacing births. The Matimba men's group also talked about how **norms** relating to childbearing had changed, as previously mentioned with regard to the number of children families have, saying '*it is unlike in the past when one would be laughed at when he doesn't have a child, that is an old saying'* (Matimba_FGD2_male_P6).

There was some overlap between the reasons given for the number of children wanted and why they wanted to space births, but also some different reasons. Caring for the child was again one of the most common reasons and this time was discussed in all groups with regard to spacing. The other main reasons were: women's health, child mobility, household budget/ poverty, and having a 'peaceful household'.

Within **caring for the child** the most important aspect of this was the child's growth and the idea that closely spaced children did not grow well: '*we*

knowingly get in trouble because of bearing children within a short time. Look, our children are not growing well' (Mbewa_FGD2_female_P9). Breastfeeding and nutrition were part of caring for the child; having to stop breastfeeding early because of a new pregnancy was considered bad for that child's nutrition, rather the child should be able to '*fully enjoy breastmilk and should start eating other food to be strong, then you can get pregnant again'* (Matimba_FGD1_female_P9). Caring for a child included being able to spend time with them and generally being *'able to give the child what it needs before another comes'* (Mbewa_FGD3_male_P1).

A child's growth was discussed much more than its health as a reason to space births; where the child's health was mentioned (in just two of the women's groups) it was in relation to healthy growth or growing in good health. Only one woman spoke specifically about child health in relation to spacing '*children have good health, as well as their mother, when you space your children'* (Mbewa_FGD1_female_P3).

Women's health was seen as an important reason for spacing births, much more so than had been discussed in regards to the number of children, and was cited by all the women's groups and one of the men's groups. It was seen that mothers needed to rest, recover and grow strong '*otherwise you get weak and your chores are affected'* (Matimba_FGD1_female_P4). Both men and women talked about the deleterious effect on women's bodies: *'Some admire how better others are, health-wise, because if you give birth within short times the body is not comfortable* [meaning it does not look good]*, but if you leave space your body looks better. When you frequently give birth your body does not get recovered; you look as if you are an old person while you are just a girl'* (Mbewa_FGD2_female_P10). Men more commonly discussed how spacing births improved how women looked and aged.

On a practical note all the women's groups and one of the men's groups mentioned the fact that the **child should be able to walk** before you have another baby. In Malawi women carry their children most of the time when they are out; if you are going to be carrying the youngest child then the older

child needs to be able to walk. Starting school was another practical reason for spacing births by five years as one child would be out of the house and the mother's care for part of the day.

The **household budget or poverty** were less commonly raised in relation to spacing births as they had been to the number of children to have. Spacing children was seen to give more time for household developments by one of the Mbewa women's groups. For the men, rapid, repeat pregnancies were harder to provide for: '*if you have an unplanned pregnancy and the hospital says you have to bring a chitenje* [a piece of material like a sarong] *when giving birth, if you fail to have one you end up delivering at the village* [because you are ashamed to go to the hospital without it], *so that's why I was saying you have to space for five years'* (Matimba_FGD2_male_P6).

The final reason that men gave for spacing births was to have a **peaceful household** as households with a lack of birth spacing or many small children were seen to lack 'peace'. Seeing other households like this was a motivating factor for using family planning.

Interestingly no one, man or woman, gave reasons such as wanting to continue, or return to, education or career / business development as reasons for spacing or limiting births. This may be because in these areas there are few career options other than subsistence farming or having a small kiosk/ shop. Everyone attending the groups had been pregnant (or their partner had), whereas women and men who have not yet started childbearing may have difference aspirations in this regard.

11.3.1.4 Why do couples succeed or fail to space / limit births?

As mentioned, both men and women talked about pregnancies occurring despite using contraception and wanting to space births or stop childbearing. A considerable portion of the discussions in all groups was about attitudes to and experiences of using family planning and contraceptive methods in general. Exploring this discussion is an important step towards understanding why couples succeed or fail to space or limit births, as contraceptive use is an important determinant of fertility.

Awareness of a variety of contraceptive methods was good; only one respondent, who had just had his first child, said '*I didn't know family planning because I have just married'* (Matimba_FGD2_men_P2). Interestingly no group mentioned vasectomy despite talking about 'closing' (tubal ligation) as a method for women. Participants were also aware of a range of locations where they could access these methods.

The barriers to using family planning could be grouped into eleven themes. First, the issue of '**availability**' was a challenge that participants of all groups had faced. Included in this theme were difficulties accessing services due to distance and transport, as well as clinics having run out of some or all contraceptive methods. For women this was compounded by their other responsibilities that limited the time available to them to go to the clinics, for example two women had missed their appointments for tubal ligation because their child had been sick.

This overlapped with the second theme, '**frequency**', within which there was a hierarchy. Implants lasting three to five years were seen as better than the injection, which lasts three months, as you did not have to keep revisiting the clinic and risk stock-outs. Similarly men and women expressed a preference for the injection over daily pills, which were considered easier to forget. One woman preferred condoms because they are used when you have sex and she thought that this meant you were less likely to forget to use them than pills.

'**Side effects'** was the third theme and was discussed in all groups; particularly abnormal bleeding patterns on the injection, probably because this was the most commonly used method. Some women had not had any problems with side effects but some had had to try a range of methods before finding one that suited them. Several of the male participants had stopped their wives from taking contraceptives altogether because of side effects, especially if they made their wife weak or affected their work. '**Partner influence**', the fourth theme was clearly important, as discussed in section 11.3.1.2. Some women were unable to go against their husband's wishes but others had taken contraception covertly.

Many of the side effects that were ascribed to contraception were valid but there were also a number of '**misconceptions**', the fifth theme, which acted as barriers. A common misconception among women was the idea that they needed to give their body a break from the injection, even if they were having no problems with it. They thought that they would be protected for some time beyond three months, either because they had had a lot of injections or because they had seen other women not getting pregnant after the injection. They were surprised when this was not the case for them: '*There are some who only have two injections and can stay for years without having another child, but some of us we can have up to 50 injections but when we say 'let me have a little breather' you find out you are pregnant' (*Mbewa_FGD1_female_P6). This was related to the sixth theme, '**following instructions**'. Despite knowing how often injections were required, women sometimes did not follow these instructions, only having one or two injections in a year, and were not able to explain why they did not go back for their appointments: *'nothing hinders me'* (Matimba_FGD1_female_P4).

Returning to the theme of 'misconceptions', this included thinking that contraceptive pills caused inflammation, tumours or cancer, that too many injections cause the uterus to become rotten or that intrauterine devices (IUDs) were causing women to get ill and even die. Some of these ideas had come from hearing handed down accounts of what had happened to friends of friends. These stories had a major impact, as explained by one participant: '*I find that there is a great change in people's attitude because fear engulfs people once something dangerous happens to someone. What changed people's attitude is that when they heard this story they thought that what had happened to this particular individual would also happen to anyone'* (Mbewa_FGD3_male_P5). This means that just hearing about other people's negative experiences, whether rightly or wrongly ascribed to contraception, influences men and women's opinions regardless of whether they have experienced any problems themselves.

A major factor in failing to space births, raised by all the female FGDs, was starting contraception too late, after you had already resumed sexual

intercourse with your partner and were already pregnant. This is discussed more fully in section 11.3.3.1.4. In the male groups this manifested as discussions about a lack of control due to sexual '**desire**', the seventh theme. For example, '*our wish is to limit the number of children, but because of desire we keep on sleeping together'* even if they knew an injection had been missed (Matimba_FGD2_male_P3). In Mbewa the men said that this was because they lacked other things to occupy them and that '*the only sweet we find is our wife; that's our fun thing'* (Mbewa_FGD3_male_P1).

Some methods were disliked because they were felt to '**interfere with sexual pleasure**', which was the eighth theme. This was only raised by men, or by women talking about men's opinions; no women talked about any method of contraception reducing their own sexual desire or pleasure. Women said that some men thought that family planning affected a woman's sexual desires, i.e. she would not want to have sex any more, or that sex with a woman who was using contraception did not feel as good. Some men felt that using a condom interfered with their enjoyment of sex, generally referred to as 'the sweetness'; as one man said *'using a condom, it's like eating your sweet while it is in its cover*' (Mbewa_FGD3_male_P3), though another man disagreed and said there was no difference. In addition, in the men's groups, there was a certain '**stigma**' attached to condoms, which was the ninth theme. Men felt that using condoms brought suspicion into the family, as they would be suspected of having affairs or having a sexually transmitted infection.[xxxii] Furthermore disposing of used condoms discretely in the family home was difficult.

In all but one of the FGDs the importance of '**blood**' was raised in relation to fertility and contraception.[xxxiii] Side effects were thought to be lower if you used a method that was compatible with your blood. Having 'hot' or 'high fertility blood' was a suggested explanation for why some women got pregnant despite using contraception.

[xxxii] HIV was not specifically mentioned in these discussions.
[xxxiii] This did not relate to menstrual blood but to the normal blood of the body.

The final two themes were the potential '**need for future children**' due to uncertainty about the permanence of the current relationship, as discussed in section 11.3.1.2, and '**religion**'. None of the participants gave religion as a reason why they had not used contraception themselves but when one group were discussing why not all women used contraception one reason given was that '*some say that the bible says multiply like sand and fill the Earth'* (Mbewa_FGD1_female_P6).

11.3.2 Postnatal check

The one-week postnatal check is potentially a crucial time-point for discussions with healthcare workers about the resumption of sexual relations and family planning. In the quantitative data it was seen that about 20% of women did not attend the postnatal check and that women who had attended were more likely to be using contraception. Exploring what women thought about the relevance of this check could be of use in encouraging attendance and thereby increasing PPFP uptake.

11.3.2.1 Why do women go, or not go, for the one-week postnatal check?

Women and men were aware of the recommendation to return to the health facility for a check-up one week after delivery. There was a strong sense across all of the FGDs that there was a need to comply with the instructions of the doctors, e.g. '*When we are told to go* [for the one-week check] *we do comply'* (Matimba_FGD1_female_P6), '*I think that it is not difficult* [to go for the one-week check] *because that's an order'* (Matimba_FGD2_male_P7) and '*I feel it is important to go back to the hospital as per instructions given after birth because the instructions are given for a purpose; it is not good to ignore them'* (Mbewa_FGD3_male_P1). This led to most participants saying it was easy to go, though one group said that the distance to the health facility and the lack of transport did make it difficult. Men's opinion was universally that '*it is never difficult to take the child back to the hospital'* (Mbewa_FGD3_male_P1) though it is almost always the woman who takes the child to the health centre so men may not fully appreciate how easy or difficult it is.

There were seen to be many benefits of attending the one-week postnatal check. Broadly speaking these fell into six main themes: checking the baby, checking the mother, getting advice on child care, being given advice about resuming sexual relations, discussing family planning and seeking help for problems. Women tended to talk more about the check as being for both their health and the health of the baby. The men did not mention the need to check on the mother's health and mostly talked about checking the baby for problems or diseases such as malaria and giving immunisations. Women discussed the need to check the umbilical stump was healing and how the baby was feeding. Being given advice on childcare, such as exclusive breastfeeding for six months, hand washing, putting the baby under a bed net to sleep and starting under-five clinics, was valued and seen as an important purpose of the visit by both men and women. It was not clear how many men attended the check but several men said that the husbands should also be given advice, for example to be reminded to wait for the mother to recuperate before having sex and about how to help with feeding.

Another area that was discussed at one-week postnatal checks was when sexual relations could resume. The advice given was generally to wait at least six weeks after birth, though one woman commented that some men would try to sleep with their wives even within the first week after birth. Only one woman in one of the groups said that family planning had been discussed with her at her postnatal check and two other women in that group contradicted her saying '*I wasn't told anything'* (Matimba_FGD1_female_P9) and '*I also was not told'* (Matimba_FGD1_female_P4). None of the other FGDs mentioned that family planning had been discussed at the one-week postnatal check without being asked and even then not all said that it had. There was, however, strong support for this to be included in the visit e.g. '*That's the right time to discuss with the doctor so that you can take part in family planning'* (Mbewa_FGD2_female_P9) and '*This is like a danger zone… because it is easy for the woman to become pregnant unexpectedly. It is vital at this time to get messages on family planning so that the couple can practice that'* (Mbewa_FGD3_male_P1).

None of the women admitted having not attended the postnatal check, yet we know from a variety of data sources that attendance at the postnatal check is not universal and I had purposively selected some women who had said that they had not gone. We must assume that the women in our groups who had not attended did not feel comfortable discussing this in the group setting. There was good awareness of the recommendation of the need for a one-week postnatal check, a strong expression of the need to comply with this and a wide appreciation of the value of this check that seemed to make attendance a strong social norm. Given this it seems it was difficult for those who had not attended to discuss the reasons why, despite having a group where all women had previously said that they had not attended. This meant we were not able to gain good insight into the reasons for non-attendance and what barriers may be amenable to change.

11.3.3 Postpartum family planning

11.3.3.1 How do men and women feel about starting and using family planning after the birth of a child?

11.3.3.1.1 What method to use for PPFP

Across all the FGDs there was strong support for the use of PPFP, predominantly for injections and implants, and for tubal ligation for those whose family size was complete. There was interest in, but little experience of, IUDs perhaps because, according to the District Health Officer, there is currently no one in Mchinji District who has been trained to insert them.

11.3.3.1.2 Why to use PPFP

There were seven main reasons why PPFP was seen as beneficial. **Avoiding pregnancy** too soon was the most frequently cited reason and came up in all groups e.g. '*This decision* [to start PPFP] *comes about with an intention of taking a bit of time before becoming pregnant again'* (Mbewa_FGD1_female_P9) and '*It is important for the mother to start family planning immediately after childbirth in order to avoid getting pregnant quickly'* (Mbewa_FGD3_male_p5).

The reasons why they wanted to avoid a rapid repeat pregnancy were similar to those given in relation to spacing and the number of children in the family in general. All the FGDs thought that PPFP was important so that the child that had just been born could **grow** and all but one group also talked about the impact on the **woman's health** or body and the need to wait for her to be ready again. Challenges in managing the **household budget** to provide for the number of existing children and the fact that this meant that **household development** could not take place were also common explanations specifically of the need to start PPFP. Several of the groups also talked about it **feeling good** to be using PPFP because you knew you were doing the 'right thing'. The final reason, which was only raised by men, was **sex**. PPFP was welcomed: '*We take family planning so that we can resume sex'* (Matimba_FG2_male_P6) and because sex would not be interrupted.

11.3.3.1.3 When to discuss PPFP

The men welcomed talking about PPFP with the healthcare workers at delivery and before discharge from the hospital or clinic. Some pointed out that the healthcare workers were very busy and often shouted at them so they would prefer to talk to the health surveillance assistants (HSAs) in the village. Women generally preferred to discuss PPFP at the one-week postnatal check, but also said they could talk about it during antenatal care and with HSAs.

11.3.3.1.4 Barriers and facilitators to PPFP

One of the main barriers to effective PPFP was starting it too late. As the women recognised, '*the time when you start taking family planning you have already slept together with your husband so it is possible to get pregnant'* (Matimba_FGD1_female_P2). When the groups discussed when PPFP should be started, the cessation of bleeding after birth, the timing of the resumption of sex and the return of menstruation were key reference points. The balance of discussion was that PPFP should be started within two months of birth so that it had been started before sex was resumed at around

six weeks,[xxxiv] though this did not seem to reflect the reality of what was practised.

Those who used the return of menstruation as a point of reference tended to think that PPFP did not need to be started until later, between six months and one year after birth, regardless of when sex was resumed. But as one woman noted '*you are not menstruating and next you notice a baby ticking inside you'* (Matimba_FGD1_female_P3). A challenge in starting PPFP was being sent back from hospital if you went before normal menstruation had resumed. Clearly menstruation is an important reference point for healthcare workers.

The male FGD in Mbewa described a 'traditional rite' that needed to be done before it would be considered acceptable to start PPFP. The participant who mentioned this had not done this himself but one of the other participants had done it once and described it as follows:

> '*I was told by the elders to prepare a fire before having sex. I was told to put the child on her mother's chest while having sex so that the child feels the warmth from the parents. Then, before ejaculation, the man withdraws pouring sperm on the fire. It is believed that the exercise protects the child from things that would endanger her health. The baby eventually gains weight and becomes healthy*' (Mbewa_FGD3_male_P2).

Other participants did not agree on the need for such practices, e.g. '*it all depends on people's beliefs because I feel* [that even] *without conducting traditional medicine no danger can happen* [to the child]*'* (Mbewa_FGD3_male_P3) and '*in all my years of raising my children I do not do such practices yet I do not have any problems'* (Mbewa_FGD3_male_P1).

Another potential barrier, described in the general discussions of family planning but mentioned in the men's discussions specifically in relation to PPFP, was that *'family planning after birth is not good because… your wife's*

[xxxiv] Six weeks is both the recommendation from the health service and the local cultural norm for postpartum abstinence.

sexual behaviour changes… mostly the sex is not as good as it used to be' (Matimba_FGD2_men_P9).

On the other hand there were several things that supported uptake of PPFP. Healthcare workers were seen as very important in influencing decisions about PPFP: '*What can make me start family planning after birth are the instructions I get from the healthcare workers after the child is born*' (Matimba_FGD2_male_P6). Messages on the radio were also mentioned, as was the role of others in the community. There were not seen to be any negative connotations of starting PPFP or of social norms against this, which is positive. However, in line with the theme of 'misconceptions' and the role of others in perpetuating these noted in section 11.3.1.4, some participants were influenced not to take PPFP by friends who had given them incorrect information. For example, one female participant had been told that she should not start family planning methods while still bleeding after birth because this would harm the child she had just had. More positively participants talked about admiring how other friends were managing their families and this being an inspiration to start family planning yourself. For women, partner's opinion was also an important influence. While there was clearly a range of external influences, both men and women described coming to their own realisation of the need to start family planning and making the decision to do so.

11.3.4 How could the uptake of PPFP be improved in Mchinji District?

Based on a consideration of the themes I identified as barriers to family planning and on participant's suggestions, this section makes recommendations on how to improve the access to family planning and PPFP in Mchinji District. I have grouped the ways in which PPFP could be improved into three themes: service delivery; information, education and communication; and male involvement in family planning.

11.3.4.1 Service delivery

Many of the barriers to starting PPFP were the same as those faced when trying to access contraception in general, and many of the barriers identified

in these FGDs have been previously observed in the literature described in section 11.1. Since women generally access PPFP at the same place that they would normally access family planning, these recommendations apply to family planning service delivery as a whole.

To increase **availability** more family planning services can be provided by HSAs in villages, removing the barriers of distance and time and their associated costs. Contraception should remain free of charge. Outreach services have been provided to some extent in Mchinji District but have been patchy, sporadic and unpredictable (resulting in unintentional discontinuation) and often have a limited range of methods available (personal observation and discussed in the FGDs). Provisions must be made to ensure that providing family planning services in the village does not compromise confidentiality. Those women who need to access services without their husband's permission may prefer to travel to a clinic, even if services are provided closer to home.

HSAs, like clinics, often run out of some or all methods, removing women's choice. Given the extensive discussions about **side effects**, and the idea of the importance of compatibility with women's **blood**, it is vital that women are able to access the method of their choice every time that they attend the clinic so that unintentional discontinuation is avoided. Several groups suggested that women should be examined in some way to help determine which method would suit them to reduce the risk of side effects. Supply chain issues and logistics must be improved to ensure that stock-outs become a thing of the past; electronic modes of supply chain management have shown potential in this regard (372, 373).

Stock-outs become less important if women choose to use longer acting methods such as implants and IUDs, addressing the issue of **frequency**. Given that women and men stated wishes to space births at four-to-five years they should be counselled and supported to actualise these desires by utilising these methods. In addition to supplies being available, healthcare workers need to be (re)trained both to counsel women and to insert and remove these devices. This training must include accurate information on

potential **side effects** and common **misconceptions,** including whether methods **interfere with sexual desire or pleasure**, so that in counselling women healthcare workers can work to dispel these myths rather than perpetuate them, as has sometimes been the case. Better explanation of the side effects, so that women know what to expect, may also reduce discontinuation rates.

Specifically on the issue of PPFP, there is clearly a need to re-educate healthcare workers about the risks of pregnancy in the postnatal period. Women who had resumed sex, and were therefore at risk of pregnancy, reported problems accessing contraception if their menstrual cycle had not yet returned. Re-orientating education on PPFP for healthcare workers towards the need to start contraceptive methods before sex resumes, rather than after menstruation returns, could help to reduce the risk of unintended pregnancy these women face. Ensuring they also understand which methods can be used at what time in the postnatal period is crucial. Healthcare workers should continue to recommend six-weeks of postpartum abstinence.

Improving uptake of longer-term methods and reducing stock-outs should decrease the reliance on condoms (except where dual-protection is required for HIV), helping to remove the barriers of **stigma** and **interference with sexual pleasure**. Where women choose shorter-term methods, such as the injection, they must be educated on the need to **follow instructions**, i.e. to return for another injection in three months. They must also be reminded that the injection will not prevent a pregnancy after this time, regardless of how many injections they have had or whether they have amenorrhoea.

Women have many contacts with the health service during pregnancy, delivery and the postnatal period. Every one of these should be seen as an opportunity to discuss contraceptive needs. Women and men in the FGDs supported the idea of discussing PPFP during antenatal care, delivery and postnatal care. This was backed up by the quantitative data, as 78-85% of women who did not recall contraception being mentioned at these times would have welcomed this discussion.

In Malawi most women attend antenatal care at least once (97.6%) and most do deliver in a health facility (73.1%) (22) so it should be possible to reach every women to discuss PPFP desires and options. Furthermore, the ability to initiate family planning immediately after delivery, such as with an IUD, as has been shown to be safe and effective, needs to be included as part of service provision (374). The main gap in service provision is in the postnatal period. In the DHS only 52.4% reported having had a postnatal check yet immunisation coverage at 12 months is high, e.g. BCG 96.3% and Diphtheria, Pertussis, Tetanus (DPT) 91.9% (22) so women are clearly taking their children to services, meaning under-five clinics are another important contact point.

A fifth of women in my data had not attended the postnatal check. Some women had not attended because the baby had died, so giving women the message that they should attend this check regardless of the outcome of the pregnancy could improve uptake. It was unfortunate that I was unable to explore reasons for non-attendance at the postnatal check, despite having taken steps to maximise the ability of women to discuss this. In order to explore this matter further one to one in-depth interviews may shed more light. In the meantime, when advising women to return for the postnatal check focusing on the benefits described by the participants of the FGDs, such as checking the health of the mother and baby and receiving advice on breastfeeding, hygiene and childcare practices, could be one way of improving attendance. It would also provide an opportunity for these women to discuss and/or start contraception if they wish to take some time before getting pregnant again or for them to be given pre-conception advice to improve their health and that of their future child if they cannot or do not want to start PPFP.

In the FGDs the postnatal check had wide support, was acknowledged as providing value and was seen to be a key time to discuss family planning having been described as a ‘danger zone’. Unfortunately it seems that this is not currently happening, or at least not consistently. Improving the discussion and provision of contraception at the postnatal check could help

to increase the uptake of PPFP and reduce the risk of unplanned pregnancies at this time. This would require the re-training of healthcare workers discussed above. Starting contraception at this visit would remove the need for the pregnancy test that healthcare workers sometimes insist on.

11.3.4.2 Information, education and communication

Despite high awareness of family planning methods there is a significant amount of misinformation, leading to **misconceptions** that pose considerable barriers to uptake. There were several misconceptions relating to PPFP, often suggesting that it would cause harm to the child that had just been born. These would need to be addressed as well as the misconceptions relating to contraception more generally. The misinformation often came from friends and other community members. Therefore, there is a need to address these issues at a community level to facilitate a supportive environment towards contraceptive uptake and continuation.

There are several ways that this could be achieved. MaiMwana Project ran a cluster randomised controlled trial investigating the effect of community women's groups working through a community action cycle on maternal and neonatal mortality and found them to be effective (327). This method could be adapted to look at issues of sexual and reproductive health. Alternatively HSAs could facilitate general community meetings to air and discuss family planning and concerns relating to it and could provide additional home visits as required. Village chiefs and elders are very important people in Malawian culture and have considerable influence over many aspects of village life. **Religious** leaders can also have substantial influence and are not always opposed to messages about family planning, depending on the denomination. Working with these key thought leaders in the community is an important way of creating a conducive environment for family planning.

Another important source of information in rural communities such as Mchinji District is from the **radio**; nobody outside of the main settlements would have a television due to cost and the lack of electricity (radios are battery-operated). Information, education and communication interventions via the radio have the potential to reach a large audience. They could include a

combination of factual information and serialised ‘soap operas’ presenting real life scenarios, problems and solutions and developing an aspiration for smaller, healthier families. Similar approaches using television have been successful in Brazil (375) and India (376). To this effect a radio programme and community group discussion intervention is currently being delivered and evaluated by MaiMwana Project in Mchinji District. It is called ‘Phukusi la Moyo’, which translates as ‘Bag of Life’, referencing the local Chewa proverb quoted in the FGDs (section 11.3.1.2) that everyone is responsible for their own lives and health and should have a full bag of skills, knowledge and experiences, which they can use when needed.

As well as addressing general issues and concerns about contraception, particular attention should be given to the issue of starting PPFP: why, when, which method and how. Messages should focus on observing the recommended six-week postpartum abstinence period and the need to start contraception before restarting sex, rather than waiting for menstruation to resume. Women and men gave many reasons for wishing to space or limit the number of children they had, often relating to the **child growing well**, the **woman’s health**, **household budget** or development and practical issues such as **child mobility**. Men may be more engaged by the inclusion of issues relating to **farming, poverty** and **population**. By tapping into these concerns and the already recognised benefits of spacing and limiting, community meetings can reinforce positive messages about family planning and continue to shift the norm to a smaller desired family size.

While the focus of these discussions was on unintended pregnancies that occur due to a lack of PPFP, the analysis of the determinants of pregnancy intention in section 8.5 showed that young, unmarried women and women with previous experience of depression or intimate partner violence were also at risk of unintended pregnancies. The issues of depression and violence were not raised in the FGDs but could be other topics for work at a community level. The issue of a lack of awareness of family planning before marriage did come up in the FGDs. While pre-marital sex is common in Malawi it is not widely accepted or acknowledged and in some areas, such

as Mchinji District, it is not considered appropriate for unmarried women to know or talk about matters of sex, contraception or even childbearing. This extends to some degree to men as one of the participants said he was unaware of family planning before marriage. Providing youth-friendly family planning services where unmarried individuals can access contraception is important and its acceptability could be improved by work at community level.

There has been recognition at government level of the risks that population growth poses to development, particularly to sustainable development, and of the key role that family planning can play (377). Under former President Joyce Banda there were billboard campaigns linking family planning to infant mortality and nutrition. While work needs to be done to meet the current unmet need for family planning, continuing to lower the desired family size through national campaigns such as these is also important.

11.3.4.3 Male involvement in family planning

This and other research has highlighted the role of the husband in decisions about family planning (378, 379). This led to interventions using 'male motivators' to be tested in another area of Malawi where they were found to lead to a statistically significant improvement in contraceptive uptake (380). This was due to easier and more frequent communication within couples.

However, due consideration should be given to how to involve men in these discussions and decisions. In Mchinji District, as in much of Malawi, there is a predominantly patrilineal system and men are the main holders of decision-making power. Mbweza et al. found that in this context, 'gender-based cultural scripts', where the husband is dominant, are more common and it may be that shared decision-making is less possible (379). In fact, inviting men into the discussion may result in an active disapproval and prevention of contraceptive use in place of previous inaction (381). Attempts to involve men need to be cognisant of these potential issues and should attempt to use 'non-gender-based cultural scripts' that focus on topics such as open communication and child welfare to promote shared decision-making (379).

Based on the findings of these FGDs using topics such as the **child's growth**, **woman's health** and appearance and **household budgeting** are likely to be themes that will engage both women and men in these discussions. Improving open communication between spouses may serve to reduce the distrust and uncertainty over the potential **need for future children**. This could open the way for greater uptake of terminal methods of family planning for those who have achieved their desired family size, reducing unintended pregnancies in this group.

11.4 Discussion

These FGDs have shown that women and men do have ideas about how many children they would like to have and how far apart they would ideally like them. Although one participant said that he had not thought about how many children to have, the way that this comment was made suggested that he did, in fact, have an idea of the number of children he wanted. However, he did not think that he had any way to actualise this, making thinking about this seem pointless. This supports Coale's theory that for fertility intentions to enter the *'calculus of conscious choice'* fertility limitation must be seen to be achievable (p53) (50).

The differences between men and women in how many children they each thought the other wanted was very interesting, and were supported by the quantitative data showing that women were more likely to report their partner's pregnancy intention to be higher than their own. Clearly communication on these issues remains difficult and it may be that the shared decision-making approach suggested in section 11.3.4.3 could help in this regard. The concern surrounding the potential need for a future child also chimes with the literature, both with the idea of 'postponement' (94), as individuals or couples may postpone the decision about whether or not to have another child while they wait to see how the relationship turns out, and with that of 'uncertainty' (93, 96) introduced in section 2.2.5.2. As Johnson-Hanks explains, this uncertainty can mean that *'even lovers are distrustful of one another's motives'* (p366) (93) and this is certainly what came across in the FGDs. The consequence of this was reliance on less effective methods

of contraception, resulting in unintended pregnancies and potentially reinforcing the distrust.

The issue of **desire** raised by men, i.e. continuing to have unprotected sex despite an awareness of the risk of pregnancy, is not one for which there is an obvious policy response. It does, however, remind us of the need to consider that for most people most of the time sex is not about reproduction, as described in section 2.2.5.1 (65, 70, 81), a fact that family planning programmes should take into account in their design.

It is reassuring that there do not seem to be many cultural barriers to PPFP and that both men and women seemed to feel positive about starting and using PPFP. The traditional practice discussed did not seem to be a common belief or practice; only one man in one group had done it and only with one of his children. However, it is particularly important to be aware of because it involves unprotected sex in the early postnatal period and could lead to an unintended pregnancy. For some this may be an important factor in decisions regarding starting PPFP.

The recommendations made in section 11.3.4 address both the supply side and demand side barriers to improving family planning uptake and PPFP in particular. Implementing the recommendations should reduce unintended pregnancies in Mchinji District as women and men will have a full bag of skills, knowledge and experiences to draw on to articulate, discuss and achieve their reproductive aims.

11.5 Chapter summary

In this Chapter I have described the rationale for exploring issues surrounding the uptake of postpartum family planning and the methodology for conducting and analysing the focus group discussions held with men and women. My analysis of the focus group discussions, using a Framework analysis approach, is presented. I have used the findings to make recommendations for ways to improve the uptake of postpartum family planning in Mchinji District, thereby reducing unplanned pregnancies. This is the end of Section II, the results Section. The next and final Chapter brings

together the findings from across the thesis to draw conclusions and make recommendations.

Section III Conclusion and Recommendations

There is only one Chapter in this Section. Here the findings from across the thesis are drawn together and their implications discussed, leading to a series of recommendations.

Chapter 12 Conclusion and Recommendations

In this, the final Chapter, I bring together the research findings to make recommendations for ways to reduce unintended pregnancies and mitigate their impact on maternal and neonatal health in Mchinji District. I also suggest some areas for further research before considering the limitations and generalizability of my findings. Finally, I outline my plans for the dissemination of these findings and recommendations.

12.1 Summary of main findings

This section briefly revisits the main findings from Section II and considers their implications. The key findings are presented in Box 12-1 at the end of the section.

12.1.1 Validation of the London Measure of Unplanned Pregnancy in Chichewa

The Chichewa LMUP is a valid and reliable measure of pregnancy intention in women who speak Chichewa. The fact that the LMUP is valid in a low-income country (LIC) helps to demonstrate that the concept of pregnancy planning is applicable in these settings i.e. that there has been a *'decline of fatalistic in favour of conative habits of thought'* (p662) (49) and that the control of one's fertility is now within the *'calculus of conscious choice'* (p53) (50). This was reinforced by the discussions of both women and men in the focus groups.

12.1.2 Pregnancy intention and its determinants in Mchinji District

Pregnant women in Mchinji District displayed the full range of LMUP scores, from zero to 12. The bimodal distribution was remarkably similar to that seen in the UK; only about 4.5% more pregnancies would be classified as planned

(score 10-12) in the UK than in Mchinji District. This is further evidence of the salience of the concept of pregnancy intention in Mchinji District.

While it could be argued that the bimodal distribution supports the dichotomisation of pregnancies into planned and unplanned, I do not think that this is the case. As we saw in section 2.2.5, the concept of pregnancy intention, the factors influencing it and the manifestation of intentions into behaviours is complex and multi-dimensional. Categorising pregnancies as planned or unplanned remains a gross oversimplification, even if a multi-dimensional measure is used as the basis on which to do this. The LMUP score provides more nuanced information about the degree of pregnancy intention and its determinants and implications. For example, using the LMUP we were able to see that every additional child a woman already has is associated with a reduction in the intention of her current pregnancy (Figure 8-5) and that every one point increase in LMUP score is associated with a reduction in postnatal SRQ score. I therefore support Barrett et al.'s conclusion that the full range of LMUP scores be used in analysis (8).

The fact that many pregnancies are planned, at least to some extent, in Mchinji District suggests that there is a missed opportunity for pre-conception care. This is particularly the case for women whose answers to the LMUP questions indicate that they were intending to get pregnant but that they did not take any pre-pregnancy preparatory actions. Given the proven benefits of folic acid in reducing neural tube defects when taken prior to conception and for first trimester, and the fact that most women did not present to antenatal care until the second trimester, this is an important missed opportunity, the reasons for which should be investigated. While the benefit of folic acid may be lost after the first trimester, the iron contained in the supplement that women are given at antenatal care may reduce iron-deficiency anaemia. This will help women to be more resilient to blood loss during delivery and may lower the risk of postnatal depression (229), so should still be promoted. There are also potential benefits for the child across its future life course as improving preconception and antenatal health could reduce the risks of non-communicable diseases in later life (382-384)

The hierarchical multivariate linear regression showed the factors associated with pregnancy intention in this setting and shed light on the discrepancies in the literature on the determinants of pregnancy intention, such as socio-economic status and maternal education, as discussed in section 8.4. The most important factors in Mchinji District were marital status, previous depression, short birth interval, being aged 15-17 years or having a partner aged 15-19 years, physical abuse in the last year and number of live children.

On this basis, the women at increased risk of unintended pregnancy could be categorised into three groups:

1. Younger, unmarried women having their first pregnancy.
2. Older, married women who had recently given birth and/or who already had as many children as they wanted.
3. Women of any age, marital status or parity who had a history of depression or intimate partner violence.

This information can be used to target family planning services to those most at risk of unplanned pregnancies, while recognising that all women and their partners should have access to services that help them to meet their reproductive health goals.

12.1.3 Impact of pregnancy intention

This research has shown that the degree of pregnancy intention has significant implications for the uptake of a range of antenatal, delivery and postnatal behaviours. In general, the less planned a pregnancy was, the less likely the woman was to access adequate antenatal, delivery or postnatal care. She was also less likely to take a range of preventative actions such as sleeping under an insecticide-treated net (ITN) or taking iron/folic acid supplements. Women with less planned pregnancies were more likely to experience problems antenatally, including antenatal depression, or during delivery. An important finding was that women with less planned pregnancies were less likely to attend the one-week postnatal check. This

may put them at further risk of unplanned pregnancy as they have missed an opportunity to discuss, or start, postpartum family planning.

Postnatally women with less planned pregnancies reported more illnesses in their babies and the babies were less likely to have slept under an ITN the night before or to have had vaccinations appropriate to their age. They were also possibly less likely to be being exclusively breastfed at the time of the postnatal interview. This implies that the babies of less planned pregnancies may receive poorer care. However, these findings are based solely on univariate analyses; multivariate analyses are necessary to properly assess these relationships before drawing firm conclusions.

Turning to the pregnancy outcomes of interest, I found no effect of pregnancy intention on the composite adverse pregnancy outcome of miscarriage, stillbirth, low birthweight or neonatal death. The lack of a relationship with low birthweight may be because there are more powerful determinants of low birthweight in this setting, as further elaborated on in section 12.3.2. Separate analyses suggest that less planned pregnancies may be associated with an increased risk of stillbirth even after taking antenatal and delivery practices into account (OR 0.94, 95%CI 0.88, 1.00), but no relationships were seen with miscarriage, low birthweight or neonatal death. The analysis was not powered for miscarriage, stillbirth or neonatal death to be considered individually; these relationships need to be investigated in larger studies.

I found a small but significant relationship between pregnancy intention and postnatal depression. The use of the hierarchical model enabled me to explore how pregnancy intention affects postnatal depression by sequentially including the determinants of pregnancy intention and antenatal, delivery and postnatal factors. While some of the effect of pregnancy intention was mediated through some of these factors, a direct effect of pregnancy intention on postnatal depression remained. The mechanism of effect could be through the psychological and/or social stress placed on the woman by the unintended pregnancy.

12.1.4 Barriers to postpartum family planning

It was interesting to note that while men and women generally wanted the same number of children (four) and the same spacing (five years), each thought that the other wanted more children than them. This seemed to be due to distrust between partners, a lack of certainty in the permanence of the relationship and difficulties discussing contraception. Men and women gave overlapping but distinct reasons for their preferences, with women more focused on their ability to care for the child and the child's growth and men more concerned with the household budget and farming issues.

There were 11 themes identified relating to the barriers to contraception in general, many of which were familiar from the literature. Side effects and misconceptions featured heavily, with women not even needing to experience side effects personally for it to influence their attitudes to different methods. Methods with longer duration of action were generally preferred due to the greater protection and decreased need to attend health services and risk stock-outs. Men particularly disliked methods that they thought interfered with sexual desire or pleasure, whether or not this was the case in reality.

There was support for, and no specific objections raised against, postpartum family planning (PPFP), but women commonly started it too late i.e. after sexual relations had already resumed. The recommended six-weeks of postpartum abstinence and the return of menstruation were important reference points for starting contraception. The latter particularly so for healthcare workers and women reported being turned away from services because of this. Discussing PPFP at antenatal care, delivery and the postnatal check were all considered acceptable.

12.1.5 Key findings

- The Chichewa LMUP is a valid measure of pregnancy intention, which is a salient concept in this setting.
- The LMUP score distribution in Mchinji District is almost the same as in the UK.
- There is a missed opportunity for pre-conception care, given the proportion of pregnancies that are planned to some extent, which would have short and long-term health benefits for the child.
- Women at increased risk of an unplanned pregnancy fall into three groups:
  - Young, unmarried women having their first pregnancy.
  - Older, married women who have given birth in the last two years or who have already completed their desired family size.
  - Women who have a history of depression or who are experiencing intimate partner violence.
- The more unplanned a pregnancy is, the less likely the woman is to access adequate care throughout pregnancy, delivery and the postnatal period or to undertake preventative practices.
- Babies of unplanned pregnancies *may* be subject to poorer care and experience more health problems.
- There was no evidence of a relationship between pregnancy intention and the composite adverse pregnancy outcome of miscarriage, stillbirth, low birthweight or neonatal death.
- There *may* be an increased risk of stillbirth in less planned pregnancies.
- Having taken the determinants of pregnancy intention and antenatal, delivery and postnatal factors into account, there is a direct effect of pregnancy intention on postnatal depression.
- There is a considerable burden of perinatal maternal mental health problems.
- Men and women want the same number of children, with the same spacing, but fail to discuss or actualise these preferences.
- The barriers to postpartum family planning are similar to those seen for contraception in general, such as side effects, misconceptions, lack of choice and stock-outs.
- Waiting to start postpartum family planning until sexual relations have resumed or menstruation has returned is common and places women at risk of unintended pregnancy.

Box 12-1 Key findings from the research

12.2 Service delivery and policy implications

I have grouped the service delivery and policy recommendations into the primary prevention of unintended pregnancies and the prevention of the adverse consequences of unintended pregnancies, or secondary prevention.

12.2.1 Primary prevention

While recognising that all women and their partners should have access to services that help them to meet their reproductive health goals, I have shown that there are three main groups of women who are at increased risk of having an unplanned pregnancy. This information can be used to target services to these women to prevent unintended pregnancies from occurring. Different responses are needed for the different at-risk groups.

Firstly, young women and men need to receive good quality, youth-friendly sexual and reproductive health services and education, whether or not they are married, to help prevent early, unplanned pregnancies. Young people in Malawi face many challenges, including early marriage, premarital sex and sexually transmitted infections including HIV (22, 385). The need for youth-friendly services has been recognised at policy level (385, 386) and Youth Friendly Health Service Standards have been developed. The 'Road Map for accelerating the reduction of maternal and neonatal mortality and morbidity' also has youth-friendly services as one of its strategies, with specific targets attached: by 2015 40% of health facilities should be providing youth-friendly services and 40% of adolescents should be using family planning (386).

These policies have been in place for five or more years but, anecdotally and from my own observation, little progress seems to have been made on the ground. It will be interesting to see the results of the evaluation of these policies. As subsequent policies are developed, the findings of my research, confirming young women to be at higher risk of unintended pregnancies, can be used to support the need for youth-friendly family planning services. The attitudes of both communities and healthcare workers towards young or unmarried people accessing these services will need to be improved. This could be done through (re)training healthcare workers as well as working

with community groups, radio programmes and community leaders. To help to demonstrate the need for further action, messages can be developed based on the findings of this research, i.e. that unintended pregnancies are associated with poorer care practices, postnatal depression and, potentially, stillbirths.

Secondly, unintended rapid, repeat pregnancies and additional children beyond the desired family size need to be prevented. The 'Road Map for accelerating the reduction of maternal and neonatal mortality and morbidity' has a target of *'60% of postnatal mothers receiving modern contraceptives'* by 2015, but no detail on how this is to be achieved (386). Based on my findings I make the following recommendations.

Pregnant women should be counselled about PPFP options during pregnancy and services should be configured to provide contraception at delivery, postnatal checks and child health appointments, according to the woman's choices. Given the expressed desires of women and men to space or limit their births, it is imperative that they are counselled on the full range of contraceptive options, including the implant, intrauterine device (IUD) and male and female sterilisation. Over the last few years the implant has become increasingly available in Mchinji District but the IUD has not, consequently its use is very low. Some of the focus group participants expressed a desire to use an IUD. In order to prevent rapid, repeat pregnancies it is vital that healthcare workers in Mchinji District are (re)trained in the insertion and removal of both IUDs and implants. IUDs and tubal ligation can be used immediately after delivery but services need to adapt to make this possible (387).

Attendance at the postnatal check needs to be improved. To do so the benefits for both mother and child should be reinforced. The messaging around this can be developed using the issues identified as important by men and women in the focus group discussions, such as checking the health of the baby and getting advice on nutrition. A discussion of contraception and the resumption of sexual relations must be made a central part of this check; the focus groups indicated that this was not currently happening. Healthcare

workers should be retrained on which methods can be used and when during the postnatal period. They should also be trained to use the WHO checklist to screen for a pregnancy (388) rather than requiring the woman to pay for a test or wait for menses to return, which places them at risk of an unintended pregnancy.

Provision of family planning services by health surveillance assistants in the community was widely supported in the focus group discussions. To be more effective they must receive adequate training and sufficient supplies to be able to meet the needs of their communities. This is already supported at a policy level (385) but the implementation has been weak and must be strengthened. Male involvement in family planning is also included in relevant policy (386); its continued rollout should be supported, encouraging men to be involved while empowering women through shared decision-making approaches.

For those women who would like to become pregnant again soon or who are not able to use contraception for some reason, pre-conception advice and support should be provided. Given the prevalence of HIV infection in Malawi (12.9% in women of reproductive age (22)), this should include advice on safer conception.

Finally, and in addition to dealing with their circumstances, particular attention should be given to the contraceptive needs of women with a history of depression or who are experiencing intimate partner violence as they are at high risk of having an unplanned pregnancy. Given the relationships between these factors and broader determinants of health, such as SES, and the general acceptance of IPV in Malawian culture (22), if not in legislation (319), individual level interventions should be supplemented with community-based programmes.

In parallel with improvements in service delivery it is important that work to legitimise smaller desired family size continues. As recognised by the government of Malawi family planning has a key role to play in sustainable development (377). The fact that each additional existing child reduces the

reported intention of the current pregnancy (Figure 8-5) suggests that smaller family sizes are becoming the preference indicating that these efforts have already started to be effective.

12.2.2 Secondary prevention

Even with the best services in the world, unintended pregnancies will always occur. In these circumstances some women will choose to terminate their pregnancy and services should be provided to allow women to do this safely. Abortion is illegal in Malawi except to save the life of the woman (28), a law that dates from 1930 when Malawi was a British colony. In recent years there has been increasing support for a review of this law given the significant contribution of unsafe abortion to maternal mortality and morbidity (29, 389). These calls have come from traditional leaders, non-governmental organisations and health experts alike (390, 391) but the Government has just ruled out a review of the law in the current parliament (392). Nevertheless, local advocacy efforts should continue to support dialogue and build support for reform. In the meantime, and in accordance with current policy (385), access to quality post-abortion care, including contraception, must be expanded.[xxxv]

For those women who continue their unintended pregnancy, the findings of this research indicate that they are less likely to access adequate antenatal, delivery or postnatal care or to take a range of preventative actions. This information can be of use to healthcare workers. If the LMUP was routinely implemented into antenatal care at the first visit and included in the health passport then the healthcare worker could gauge how planned the pregnancy was and would know whether the woman was likely to neglect her own care. Having identified these women, the healthcare worker could then take steps to provide additional counselling and support to encourage and enable them to access adequate care and take up the recommended preventative practices.

[xxxv] It is disappointing, but illuminating, to note that there is no mention of abortion or post-abortion care in the 'Road Map for accelerating the reduction of maternal and neonatal mortality and morbidity.'

According to this research, these women are also at increased risk of postnatal depression, something that is not routinely screened for in Malawi. The antenatal LMUP score could be used to flag women who are at risk of postnatal depression and who should be assessed after birth. Until universal screening for postnatal depression is introduced this targeted approach should not overburden healthcare workers but would facilitate the detection of more women experiencing postnatal depression. Refresher training for healthcare workers on the management of mental health issues may be required, as I provided during this research.

This secondary prevention can also link back to primary prevention as women who have experienced one unintended pregnancy are at risk of experiencing another (243-246). Women with a current unplanned pregnancy must receive counselling during pregnancy, at delivery and postnatally on their family planning options. Where possible a plan could be made during pregnancy for a method to be commenced at delivery (e.g. the IUD) or at six weeks (e.g. the implant), in accordance with the woman's choice.

A considerable burden of perinatal anxiety and depression and intimate partner violence was uncovered during this research. Mental health is often neglected in health services and Malawi is no exception. Consideration should be given as to how best to meet this need in the context of a resource-limited environment. Likewise how best to tackle the issue of intimate partner violence and support women who are experiencing this requires considerable further work.

12.2.3 Key recommendations

Primary prevention

Youth-friendly services

- Genuine provision of youth-friendly sexual and reproductive health services.
- Work with communities and healthcare workers to improve the acceptability of providing contraception to young and unmarried men and women.

Postpartum family planning

- Counsel women and their partners on their postpartum family planning options at antenatal, delivery and postnatal care, including child health clinics.
- (Re)train healthcare workers to insert and remove implants and IUDs to facilitate the desired birth spacing interval.
- Increase provision of contraception at the time of delivery.
- Retrain healthcare workers on contraceptive use in the postnatal period, initiation before sex resumes and the use of the WHO checklist to screen for pregnancy.
- Improve attendance at the postnatal check and make contraception and advice about the resumption of sexual relations a central component of this visit.

Family planning in general

- Increase the availability of a range of contraceptive methods at community level through health surveillance assistants.
- Improve method mix and supply chain management to prevent stock-outs.
- Work with communities, healthcare workers and mass media to address myths and misconceptions and manage side effects.
- Screen women for depression and intimate partner violence at every health service contact, refer them to services as appropriate and consider their contraceptive needs.
- Facilitate male involvement and shared decision-making in family planning.
- Continue work to legitimise smaller desired family size.

Box 12-2 Key recommendations for primary prevention of unintended pregnancies

Secondary Prevention

- Local advocacy efforts to legalise abortion should continue.
- Post-abortion care must be made available, in accordance with current policy.
- Include the Chichewa LMUP in routine antenatal care at the first visit to identify those at risk of inadequate uptake of care and provide additional counselling and support to mitigate these risks.
- Screen pregnant women using the Chichewa LMUP to identify those at risk of postnatal depression and assess them in the postnatal period.
- Make plans for postnatal family planning with women who are currently experiencing an unplanned pregnancy.

Box 12-3 Key recommendations for the reduction of the impact of unintended pregnancies

Other recommendations

- Provide pre-conception advice to women who would like to become pregnant again soon or who are not able to use contraception.
- Investigate ways to increase the uptake of iron/folic acid supplementation before pregnancy and during the first trimester.
- Maternal mental health services should be reviewed and upgraded as there is a significant burden, particularly during the antenatal period, which is currently undetected and untreated.

Box 12-4 Other recommendations

12.3 Future research recommendations

12.3.1 Using data already collected

I collected a huge amount of data during this research, not all of which could be analysed and included as part of this thesis. What follows are some of my ideas of areas that I would like to investigate further using these data.

All the women were asked the standard DHS pregnancy intention question (Box 2-2) at postnatal follow-up. While this is much nearer to birth than the DHS would normally be asked (as it is asked about births occurring in the last five years) it enables a comparison with the antenatal LMUP score to see whether there is any added value in asking the LMUP instead of the DHS

question, and in doing so antenatally, when estimating the prevalence of unintended pregnancy.

Two-thirds of the women were also asked the LMUP postnatally so that I can compare the postnatal LMUP score with the DHS question, as well as assessing the stability of the LMUP score between the antenatal and postnatal measurements. Furthermore, the order of the LMUP and DHS questions postnatally was randomised, with half of the women answering the LMUP first and the other half the DHS first. This will allow me to explore whether there is any impact of the ordering of the questions, as was found by Kaufmann et al. (113) but has otherwise not been studied.

I would also be interested to redo the main analyses of the relationships between pregnancy intention and pregnancy outcome using the postnatal LMUP score and responses to the DHS questions as the measure of pregnancy intention instead of the antenatal LMUP score. This would allow me to see whether there is a relationship using these methodologies and whether my methodology is an explanation for the lack of relationship with low birthweight seen in my data. This would then suggest that the apparent relationship that others have seen might be a function of the methodology they used. Another potential explanation is explored in section 12.3.2.

The univariate analyses showed that many behaviours and care practices were associated with pregnancy intention. There is so little published evidence in this area, in particular on practices of relevance to low-income countries, that I would like to explore the relationships between pregnancy intention and these behaviours further in multivariate analyses.

Due to the time constraints posed by the research Fellowship I originally thought it would only be feasible to examine outcomes in the neonatal period. In fact, using my original budget I was able to revisit some women at six and 12 months postnatally and collect further rounds of data. I added new questions into these visits, including validated measures of quality of life and food insecurity as well as assessing the growth and developmental milestones of the infant. Using these data I would particularly like to look at

the relationship between antenatal pregnancy intention and postnatal depression later in the postnatal period, given that women remain at risk for 12 months after delivery. I would also be able to explore the natural history of perinatal depression, investigating the extent to which antenatal depression persists into the postnatal period, the factors associated with continued depression and whether there are any differences between women who experience antenatal or postnatal depression. These data also offer the opportunity to look at the impacts of pregnancy intention on growth and development after the neonatal period and the potential implications of this for health across the life-course.

I would like to look at feeding practices again. In the neonatal period there was too little variation in breastfeeding practices to be able to investigate the relationships between pregnancy intention and feeding practices, though there was a suggestion that exclusive breastfeeding was becoming less common in women with less planned pregnancies. This, coupled with the evidence that the babies born from less planned pregnancies may receive poorer care and experience more health problems, indicates that these children may be disadvantaged. Analysis of the longer follow-up could investigate whether this is indeed the case.

I would also like to further explore the relationships between pregnancy intention, food insecurity and low birthweight. For instance, using the food insecurity questions I could stratify on adequacy of food and investigate the relationships between pregnancy intention and low birthweight in those with and without enough food.

The prevalence and determinants of intimate partner violence, miscarriage, stillbirth, low birthweight and neonatal death in Malawi are other areas that could be investigated using the existing data and would fill gaps in the literature.

12.3.2 New data collection

The Chichewa LMUP is now an available tool for research and surveillance in Malawi and can be used for a range of research questions pertaining to

pregnancy intention. I have already had discussions with another group in Malawi who are interested to use it in their work. This should lead to further insights for the provision of family planning programmes to aid Malawi in designing programmes to meet the unmet need for family planning.

Despite recruiting over 4,200 pregnant women, this cohort was not large enough to be able to investigate the relationships between pregnancy intention and miscarriage, stillbirth or neonatal death individually. Within the time and budget constraints of my Fellowship a study of sufficient size was not possible – even if the whole district had been included for the duration of data collection it would still have been underpowered. The suggestion of an increased risk of stillbirth with lower pregnancy planning is interesting and warrants further investigation in larger scale studies; studies that would also be able to include miscarriage and neonatal death in their outcomes.

I was surprised by the lack of a relationship between pregnancy intention and low birthweight in these data given that there is a considerable amount of evidence for a relationship in the literature. However, most of this evidence is from high-income countries (HICs) using retrospective cross-sectional designs. The methodological differences may be the explanation; an alternative explanation is that the relationship exists in HICs but not in LICs. In Mchinji District 54% of children under the age of five are stunted, 3% of women are less than 145cm tall, 10.6% have a body mass index of below 18.5, 22% are anaemic (22) and, as we saw in section 7.4.3, many women report seldom having enough to eat. In this context there are clearly much more important determinants of low birthweight than pregnancy intention.

In HICs, where maternal malnutrition and other adverse circumstances such as poor sanitation and infection are less common, pregnancy intention may play a more important role in influencing birthweight. Introducing the LMUP into routine antenatal care in the UK and following up these women after the end of the pregnancy would help to shed some light on this apparent discrepancy between the literature and my results.

My research has found evidence of a direct effect of less planned pregnancies on the experience of postnatal depression. I have suggested that this may be due to stress; further work in this area could look at objective measures of stress e.g. salivary cortisol, to test this theory.

12.4 What this research adds

This research has contributed to the understanding of pregnancy intention and the relationships between it and maternal and neonatal health in several ways. As noted in section 2.3 and Chapter 3, the current evidence base is limited and flawed. It is based on inaccurate measures of pregnancy intention that are often uni-dimensional, use a single DHS-style question to dichotomise pregnancies into planned or unplanned and ask these questions after the birth of the child, omitting pregnancies that do not end in a live birth. Most data are cross-sectional meaning that reported intention could be influenced by the outcome, making any comment on cause and effect impossible. Moreover, data from low-income countries and on the relationships between pregnancy intention and maternal behaviours are lacking in the literature.

I designed my research with an awareness of these limitations in mind and took steps to overcome them wherever possible. To maximise the accuracy of the assessment of pregnancy intention I used the psychometrically validated London Measure of Unplanned Pregnancy, based on a multi-dimensional concept of pregnancy intention. I did not dichotomise pregnancies into planned or unplanned but used the full range of LMUP scores in all analyses. I also assessed pregnancy intention during pregnancy rather than after birth. This has reduced recall bias as it has shortened the interval between the period of interest and the time of the interview. While this is still a retrospective measure in terms of intention (because the woman is already pregnant), data published since I designed this research have suggested that there is a reasonable level of agreement between a measure of intention during pregnancy and a prospective measure before pregnancy (109), further supporting this approach.

I based my research on a cohort of pregnant women who were followed up postnatally to assess the outcome of the pregnancy. Although early pregnancy losses could not be captured, my analysis was done on pregnancies, not on live births, making it more representative of the range of possible outcomes and therefore of reality. It also means that pregnancy intention was measured during pregnancy, before any outcome has occurred, unlike cross-sectional surveys. This removes any potential for the reported intention to be influenced by birth outcomes and allows some consideration of cause and effect.

I believe that this design has allowed me to make a truer assessment of pregnancy intention and, therefore, of the determinants of pregnancy intention and the relationships between pregnancy intention and outcomes. The fact that I used the full range of scores and hierarchical analyses has allowed me to show the extent to which each determinant affects pregnancy intention as well as how behaviours and outcomes vary according to the degree of pregnancy intention. This has not previously been reported, even where the LMUP has been used. I have also been able to explore how pregnancy intention influences the outcome of the pregnancy through antenatal, delivery and postnatal care and practices.

This research also contributes to filling a gap in the evidence base on the relationships between pregnancy intention and health outcomes in low-income countries. In particular miscarriage, stillbirth and mental health issues are frequently overlooked whereas this research examines these as its primary outcomes and provides estimates of their prevalence as well as some information on their determinants. I have also looked at the impact of pregnancy intention on a range of behaviours and care practices that are relevant to these settings, such as the use of insecticide treated bed nets and malaria prophylaxis uptake, on which I found no previously published evidence.

12.5 Capacity development

Although not formally part of my Fellowship I contributed to capacity development for my project team and for MaiMwana employees. I taught at

regular MaiMwana training sessions, for example on basic statistics, epidemiology, study design and paper writing, and supported MaiMwana employees with poster design and paper writing. I provided bespoke training on the development of electronic data collection tools for those who were interested in learning how to do this. I also trained the supervisors to use various software packages, particularly developing their skills in Excel, and trained them on topics requested by them to improve their future employability. Finally, I supported them financially and practically to undertake on-line distance learning with People's Uni[xxxvi]. To date all three have been awarded a Diploma in Public Health and are considering continuing their studies towards gaining a Masters in Public Health.

12.6 Limitations

The main limitation of this research was that, due to the way in which pregnancies were recruited through the surveillance system, early miscarriages and induced abortions were missed. This is perhaps less important for the early miscarriages, many of which are not recognised or preventable and are probably unrelated to intention. However, the omission of induced abortions is important as it will result in an underestimate of the prevalence of unintended pregnancy and of its effect on adverse pregnancy outcome, particularly as most of these abortions will be unsafe, posing a high risk to the mother's health. While abortion continues to be illegal in Malawi capturing this information will always be a challenge, as abortions will be sought covertly.

It would have been possible to recruit women earlier had a different methodology been used. Women in the defined research area could have been visited monthly and asked questions and/or given a pregnancy test to facilitate earlier detection of pregnancy. However, this is a resource and time-intensive process that was not feasible within the constraints of my budget.

[xxxvi] People's Uni is an open access education initiative aiming to contribute to improvements in the health of populations in low- to middle-income countries by building Public Health capacity via e-learning at very low cost: http://www.peoples-uni.org

Some of the questions used to gather data had weaknesses, which could affect the validity of the results. For example, the Abuse Assessment Screen had not been validated in Chichewa, the local language, and the questions used for support, control and food insecurity were single questions attempting to capture multi-dimensional concepts. At the time there were no locally validated questionnaires and it was not possible for me to validate all of these measures. While, to my knowledge, there is still no locally validated screening tool for intimate partner violence, there has been work in some of the other areas. The Household Food Insecurity Access Scale has now been translated into Chichewa and is being used by another group and the Multidimensional Scale of Perceived Social Support is currently being tested in Malawi.

An important limitation is the omission of the role of HIV. Given the research design, where data collectors were living in the communities from which they were collecting data, asking women to disclose their HIV status was felt to be neither ethical nor reliable so I was not able to collect data on HIV status. However, HIV status (and anti-retroviral therapy) could play an important role in both pregnancy intentions and pregnancy outcomes as well as on women's fertility. Adverse pregnancy outcomes may be more common in HIV positive women (393, 394), especially those who do not know their status or who are not receiving treatment. The relationships between HIV status and pregnancy intention are more complicated and are probably contextual. In Swaziland Warren et al. found that being HIV positive made no difference to the reported intention of women's last pregnancy (395), whereas in Malawi Dube et al. found that HIV positive women were more likely to report wanting no more children than HIV negative women, even after adjusting for age, education and number of children (396). To date none of the studies investigating the determinants of pregnancy intention have included HIV status (see Table 3-8), but this is an important area for future research.

There is a potential for miscarriages and stillbirths to be misclassified as these were based on the mother's estimate of the gestation of the

pregnancy. Stillbirths and neonatal deaths could also have been misclassified. Since these outcomes were combined for the main analysis this was less of a problem. The lack of a reliable way of assessing the gestation of the pregnancy also meant that I could not include pre-term birth as an adverse pregnancy outcome, even though it had previously been shown to be related to unplanned pregnancy (21). Data on gestation at birth is poorly recorded in the hand-held notes (personal observation) and is based on the healthcare worker's assessment, rather than objective criteria. At the moment I cannot see a way in which these data could be collected reliably in this setting.

Many of the questions relied on women's self-report and the answers were not objectively verified, which is a potential limitation. Data collectors were trained to verify answers using the woman's or the child's health passport where possible, e.g. for antenatal care uptake, date of birth, birthweight and immunisation status. Questions about the health of the woman and the baby were based on those used in the DHS for estimating the prevalence of maternal and childhood illnesses. Using self-reported health for the assessment of morbidity is not perfect but has been widely used and is thought to have reasonable validity (397-399).

Although in section 2.3.2 I recognised the important role of the partner's intentions and that many studies are limited by its omission I was not able to include partner's intentions in this research. This was because men were generally not available for interview during the home visits (personal observation). Had we attempted to include partners we would probably have had a very unrepresentative sample. While I did ask women to report their partner's intention there was such high correlation with their own intention that this did not have any further explanatory power.

The main limitation in the qualitative data was that I was not able to find out why women did not attend the postnatal check, even though I had a focus group where all the women had previously said that they had not been. Clearly the social norm of attendance was too strong for women to feel comfortable saying in front of a group that they had not gone. The fact that

women had admitted this in the one-to-one interviews suggests that in-depth interviews may be a better way of exploring the reasons for non-attendance.

12.7 Generalizability

The Chichewa version of the LMUP is valid for use in the wider Chichewa speaking population of Malawi and is freely available online to facilitate this.

The high recruitment rate (>99% of eligible women) and low loss to follow-up (6%) suggest that the cohort is representative of pregnant women in Mchinji District. The findings are therefore generalizable from the cohort to the rest of the District. Mchinji District is very similar to the Malawi national average for many relevant indicators, such as total wanted fertility rate and unmet need for family planning, and on socio-demographic and socio-economic measures. This should mean that the findings are generalizable to Malawi as whole, though this may be less true where communities are matrilineal rather than patrilineal if women have more decision-making power.

The high levels of unplanned pregnancy, unmet need for family planning and total fertility rate seen in Malawi are common across much of sub-Saharan Africa. Furthermore, many of the determinants of unintended pregnancy seen in this research were similar to those seen in other low-income country settings. This suggests that these findings may also have wider applicability in the region.

Whether or not these findings are generalizable to high-income countries is uncertain given the many differences between the contexts. Adverse pregnancy outcomes are much less common in HICs than LICs and abortion is generally more accessible to women in HICs, meaning that fewer unintended pregnancies result in live births and removing some of the risk. However, unintended pregnancies are just as common in HICs (e.g. 51% in the USA (400), 45.2% in the UK (63)) and many of the determinants of unintended pregnancies in HICs are the same as those seen both in this research and in other LICs. Yet the relevant schemata and structures pertinent to pregnancy intentions are likely to vary across different cultural settings, meaning that the determinants of pregnancy intention will also vary,

which may limit the generalizability of my findings. Another possibility is that the relationships are the same but the effect sizes differ.

With regard to the relationship between pregnancy intention and postnatal depression it can be argued that women in HICs are just as prone to the psychological and social stress of an unplanned pregnancy. Therefore the increased risk of postnatal depression with less planned pregnancies seen in Mchinji District, even after accounting for the determinants of pregnancy intention and antenatal, delivery and postnatal factors, may also exist in HICs. Notwithstanding the limitations of the current evidence, it does support a relationship between pregnancy intention and postnatal depression in HICs (180), suggesting my findings may be generalizable. Prospective studies in HICs that include assessments of previous and antenatal depression are needed to confirm this.

My research found no relationship between pregnancy intention and low birthweight, contrary to the data from HICs (21). I have suggested that in Mchinji District malnutrition, stunting and food insecurity may be more important determinants of birthweight than pregnancy intention. Methodological factors are another possible reason for the lack of a relationship. On the basis of my findings I cannot conclude that there is no relationship between pregnancy intention and low birthweight in HICs; further work in HICs would be needed to determine this.

The lack of relationship I found for miscarriage and neonatal death may have been due to a lack of power, so no generalizable conclusions can be drawn from this. The possible relationship seen for stillbirth may be applicable in HICs but to confirm this, and to investigate the relationships for miscarriage and neonatal death, larger prospective studies are needed in HICs and LICs.

Qualitative work does not aim to be generalizable in the same way that quantitative research does. My findings are primarily of relevance to Mchinji District. However, many of the themes raised, particularly in terms of barriers to family planning, were consistent with those seen in the wider literature. They may therefore offer some insight to other areas in Malawi seeking to

improve the uptake of family planning and of postpartum family planning in particular.

12.8 Dissemination

During the course of my Fellowship I presented my findings at various internal and external meetings and conferences, as well as publishing two papers. These dissemination activities are detailed in section 12.8.1. Further dissemination activities, including local dissemination, are planned, as described in section 12.8.2.

12.8.1 Papers, posters and presentations given

To date I have published two papers from the work in this thesis. The first was the validation of the Chichewa LMUP (Chapter 6 and Appendix X). The second was work with colleagues comparing our experiences of using different methods of electronic data capture in Mchinji District (Appendix O). I also contributed to a letter about a paper that had attempted to convert the LMUP to a prospective measure (401).

I have presented posters at several conferences, both nationally and internationally:

- Validation of Chichewa LMUP
    - UCL Institute for Women's Health 8th Annual Meeting, May 2013 (where I was awarded the best poster prize).
    - First Global Conference on Contraception, Reproductive and Sexual Health in Copenhagen, May 2013.
    - Global Women's Research Society Conference, Birmingham, November 2013.
- Determinants of Pregnancy Intention
    - UCL Institute for Women's Health 9th Annual Meeting, April 2014.

- Using Electronic Data Capture in rural Malawi
    - UCL Festival of Digital Health, June 2014.

I have also given several conference presentations as the findings have evolved:

- Determinants of Pregnancy Intention
    - MamaYe Reproductive Health Seminar, Lilongwe, Malawi, November 2013.
    - Fertility Transition in the South, University of Oxford, April 2014.
    - Global Women's Research Society Conference, London, March 2015.
- Overview of my research and main findings
    - Wellcome Trust Bloomsbury Centre for Global Health Scientific Meeting, Zimbabwe, March 2015.

My colleague presented our work on electronic data capture in rural Malawi at the 8th 'Health Informatics in Africa Conference' in October 2013 in Kenya.

I have also contributed data to the current WHO estimation of stillbirths and to concurrent research at MaiMwana Project within agreed data sharing and data protection guidelines.

12.8.2 Planned dissemination activities

12.8.2.1 Planned papers

The following papers are planned:

– Literature review of pregnancy intention and primary outcomes – based on Chapter 3 – possibly to Studies in Family Planning as they published the last review on this area in 2008.

– Determinants of pregnancy intention – based on Chapter 8 – possibly to PLoS One as they have published two similar papers in the last three years.

– Relationships between pregnancy intention and pregnancy outcome – based on Chapters 9 and 10 – possibly to The Lancet Global Health.

– Findings of the qualitative work on postpartum family planning – based on Chapter 11 – possibly in International Perspectives of Sexual and Reproductive Health as they published similar qualitative work from Burkina Faso.

Other potential papers include:

- Methodological papers on the analysis of pregnancy intention using the LMUP as an outcome measure, and the post-delivery re-test of the LMUP and comparison with the DHS measure.
- Prevalence and determinants of miscarriage, stillbirth, low birthweight and neonatal death in Malawi.
- Prevalence, determinants and pregnancy outcomes associated with intimate partner violence in Malawi.
- Analysis of the natural history of perinatal depression (in collaboration with psychiatrists Dr Stewart and Dr Gleadow-Ware).

12.8.2.2 Conferences

Abstracts have been submitted for the findings on the relationships between pregnancy intention and maternal and neonatal health and for the findings of the qualitative work to the following conferences:

- July 2015 – UCL Institute for Women's Health 10th Annual Meeting.
- Oct 2015 – Global Maternal Newborn Health Conference.
- Nov 2015 – Fourth International Conference on Family Planning.

I have also been invited to present my findings at the 9th World Congress on the Developmental Origins of Health and Disease in November 2015. Abstracts will be submitted to other conferences, including national conferences in Malawi, as the opportunity arises.

12.8.2.3 Dissemination in Malawi

There will be three tiers of dissemination in Malawi.

Firstly, I will use the findings of the quantitative and qualitative work to create a piece of interactive theatre and a song. I will do this with colleagues at MaiMwana Project who have experience in this field and I can draw on contacts and expertise at 'Theatre for a Change' in Lilongwe.[xxxvii] This project will the go 'on tour' around Mchinji District to feed back the results of the research to the participants. I believe that this will be a more effective and meaningful way of communicating the results back to the community.

Secondly, I will prepare a brief report summarising the main findings of the research for the District Health Officer, the District Medical Officer, the District Nursing Officer and the District Executive Committee. All relevant parties will be invited to a project closure meeting at the District Executive Committee where I will present the results.

Finally, I will meet with policy makers in the Department of Reproductive Health at the Ministry of Health to the discuss policy implications of these findings.

12.9 Concluding thoughts

My main aim with this research was to explore the relationships between pregnancy intention and maternal and neonatal health outcomes in as methodologically robust a way as possible. In so doing I have proven that the concept of pregnancy intention is valid in a low-income country and I have shown the London Measure of Unplanned Pregnancy to be a viable way of measuring intention. I identified three groups of women who are at increased risk of unintended pregnancies, explored in depth the reasons behind the poor uptake of postpartum family planning and outlined suitable policy responses to prevent unintended pregnancies.

[xxxvii] Theatre for a Change aims to improve sexual and reproductive health and rights, particularly of vulnerable and marginalised groups, using participatory tools. http://www.tfacafrica.com

By assessing intention during pregnancy with a validated measure of pregnancy intention and following women up postnatally to ascertain the outcome of the pregnancy, I have avoided many of the pitfalls of previous research. Using the full range of LMUP scores and a hierarchical approach to my analysis I have been able to explore the ways in which pregnancy intention influences pregnancy outcome. I found that less planned pregnancies were associated with poorer uptake of preventative care and practices, an increased risk of postnatal depression and possibly an increased risk of stillbirth. This information can now be used to try to mitigate the impacts of these unintended pregnancies through screening in antenatal care and the provision of additional support. The fact that I did not find a relationship with low birthweight is intriguing and leads to the question of whether this is due to my more robust methodology or to the genuine absence of such a relationship in this setting.

Though not part of the primary focus of my research, I uncovered several other noteworthy findings. I demonstrated the marked similarity in the distribution of pregnancy intention in Mchinji District and the UK, highlighting the potential for pre-conception care in the both settings and the need for more work in this area. Furthermore, I revealed a considerable burden of perinatal maternal mental health issues, particularly in the antenatal period, in Mchinji District. I was also able to show the importance of intimate partner violence in relation to unplanned pregnancies and maternal and neonatal health. There is much more that can be learned from the data I collected, for example developing multivariate models to explore the relationships of pregnancy intention to maternal behaviours, describing the determinants of various maternal and neonatal outcomes, exploring the natural history of perinatal maternal mental health and comparing the different methods of assessing pregnancy intention that I employed during the data collection.

Overall, this research has met it aims, contributing to the literature in this field and to the data on pregnancy intention and its determinants and implications in a low-income country. It has provided a wealth of information on pregnancy intention, family planning and associated factors that can be used

to reduce the unmet need for family planning and the prevalence and impacts of unintended pregnancies in Malawi.

Ultimately I hope that the insight gained from this research will be put to use to enable women and their partners to choose if, when and how many children to have. By supporting couples to avoid unplanned pregnancies and achieve their desired family size they will have smaller families by choice. Each child then receives a greater share of the family's resources and is less likely to miss out on food, healthcare or an education and to more likely to have better health across the life course. This enhances their future employment prospects, means they are more likely to be healthy and to have a smaller family of their own, slowing population growth and perpetuating a virtuous cycle. If this is realised, it will have significant impacts on maternal and child health and broader impacts for education, population, economic growth and development in Malawi.

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Chapter 13 Appendices

Appendix A Fellowship award letter

wellcome trust

Private and Confidential

Professor Anthony Costello
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Our Ref: 097268/Z/11/Z

17 January 2012

Dear Professor Costello

I am writing to let you know that the Trust has agreed to award University College London a grant of up to £323,318 to provide a Research Training Fellowship for Dr Jennifer A Hall, over 36 months for her study entitled "What are the relationships between the degree of pregnancy intention and key neonatal and maternal outcomes in the Mchinji district of Malawi?", under your sponsorship and the supervision of Professor Judith Stephenson and Dr Andrew Copas.

The grant has been given a notional start date of 1 September 2012 and is intended to provide support as follows:

RING-FENCED FUNDS

Clinical Fellow	
Dr Jennifer A Hall	172,684
Overseas Allowances	
Airfares	5,000
Subsistence	11,900
Visa	100
Vaccination	200
Malaria Prophylaxis	815
Freight costs	1,500
Sub Total	£192,199

TRANSFERABLE FUNDS

Other Research Staff	
Field interviewers x 25	30,000
Data quality supervisors x 3	16,200
Inflation Allowance	2,139

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Flexible Funding Allowance	3,146
Travel To Meetings	
Dr Jennifer Hall	4,500
Equipment	
Desktop computer	1,500
Netbook computer x 3	2,250
Laptop	1,800
Additional battery for laptop	175
External hard drive as desktop back up	60
USBs x 6	90
Digital Dictaphone x 2	190
Bicycle x 25	2,075
Motorcycle x 3	13,800
PDAs x 25	950
Weighing scales x 25	150
Measuring mat x 25	1,000
Bags x 28	280
Other	
Recruitment	648
Translator payment	60
Ethics application in Malawi	9,055
MaiMwana administrative costs	9,055
Training	
Two week training of interviewers and supervisors	4,308
Training courses	4,100
Workshop Costs	
Consensus discussion of the LMUP	32
Briefing of key informants	3,883
Briefing of MaiMwana staff	96
District Executive Committee meeting	450
Biannual and quarterly meetings	10,182
Meetings for local dissemination of findings	1,840
Focus groups	2,000
Research Expenses	
Rent and utilities	655
Fuel for supervisor's visits	1,440
Office equipment	750
Software licences	600

Pre-testing of the LMUP	260
Field-testing of the LMUP	400
Vehicle hire	1,000
Sub Total	£131,119

GRAND TOTAL

Total	£323,318

Ring-fenced funds may only be used for the purpose stated above. The budgets for transferable funds are indicative only and movement of funds between these budget headings is allowed without prior permission from the Trust. However, prior permission is required if the funds are needed for any other purpose.

The ring-fenced funds provided for Dr Hall include a basic starting salary of £39,968 per annum, as set by the Host Organisation, plus inflation.

The grant is cash-limited; supplementary funding will only be provided in specific circumstances (see Information to Note).

The Trust anticipates that Research Training Fellows will be able to focus on their research throughout the duration of their fellowship. Clinical duties should be restricted to a maximum of two programmed activities per week, where appropriate, and only if agreed by the supervisor.

The Trust's Grant Conditions (COND/10/11), referred to in the attached Information to Note, detail the conditions under which the grant is awarded.

We would remind you that with regard to clause 6 (iii) of the Grant Conditions, all research papers that have been accepted for publication in a peer-reviewed journal, and are supported in whole or in part by Wellcome Trust funding, must be made available from PubMed Central and UK PMC as soon as possible, and in any event within six months of publication, in line with our Open Access policy http://www.wellcome.ac.uk/About-us/Policy/Spotlight-issues/Open-access/.

It is a condition that the Head of your Host Organisation will administer the grant in accordance with the purposes for which it has been awarded. I should be grateful if your Organisation would confirm, in writing, the acceptance of this grant on the conditions detailed in this letter and the notes. A Grant Start Certificate for this purpose can be downloaded from the Trust's website (see Information to Note). The grant cannot be activated until this confirmation has been received. The Trust will not accept liability for any expenses incurred on the grant until a signed Grant Start Certificate has been returned.

When accepting this Award of Grant, the Organisation recognises that the UNDERTAKINGS given by the Organisation and others at the time of signing the Application Form are "conditions precedent" and the Organisation will ensure that they, their agents, servants, employees and students will continue to abide by the undertakings given throughout the lifetime of the grant.

Copies of this letter and the notes should be forwarded to the Head of your Host Organisation, your Head of Procurement, your Research Grants Office and your Finance Officer. For payment of grant funds see Information to Note.

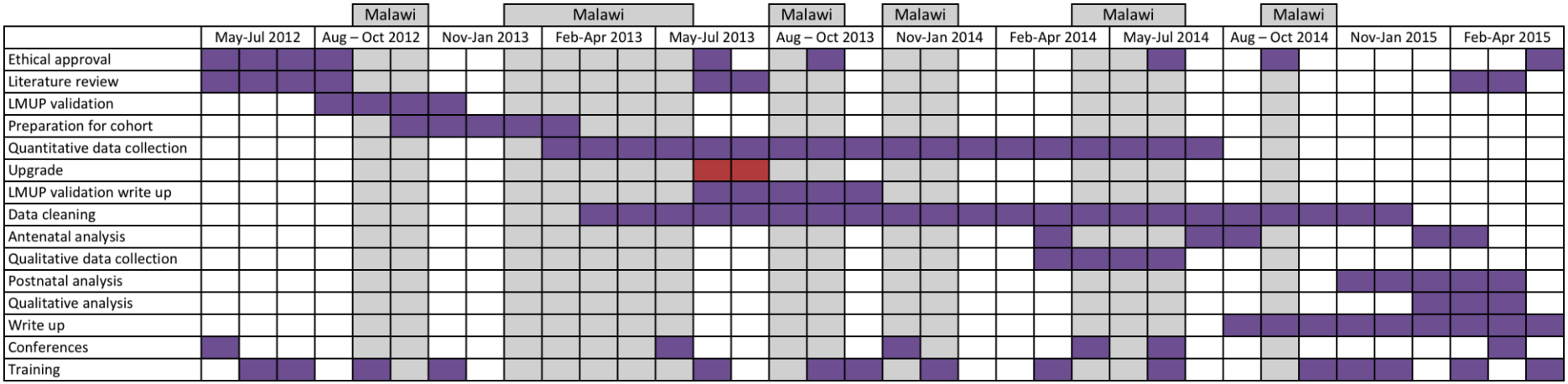
If you would like to discuss any issues regarding the grant, please contact me at this office.

Yours sincerely

EBurrowes

Dr Elizabeth Burrowes
Populations, Immunology and Public Health
Grants Adviser

Appendix B Research timeline



Appendix C Ethics approval letters

CERTIFICATE OF ETHICS APPROVAL

This is to certify that the College of Medicine Research and Ethics Committee (COMREC) has reviewed and approved a study entitled:

P.08/12/1273 - What are the relationships between the degree of pregnancy intention and key neonatal and maternal outcomes in the Mchinji District of Malawi by Dr. Jenny Hall

On 4th October

As you proceed with the implementation of your study, we would like you to adhere to international ethical guidelines, national guidelines and all requirements by COMREC as indicated on the next page

Approved by College of Medicine

04 OCT 2012

(COMREC) Research and Ethics Committee

Dr. G. Kalanda - Vice-Chairperson (COMREC)

04 October 2012

Date

2UCL RESEARCH ETHICS COMMITTEE
GRADUATE SCHOOL OFFICE

Professor Judith Stephenson
Institute for Women's Health
UCL

18 July 2012

Dear Professor Stephenson

Notification of Ethical Approval
Project ID: 3974/001: What are the relationships between the degree of pregnancy intention and key neonatal and maternal outcomes in the Mchinji district of Malawi?

I am pleased to confirm that your study has been approved by the UCL Research Ethics Committee for the duration of the project i.e. until April 2015.

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

   Reporting Non-Serious Adverse Events
   For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

   Reporting Serious Adverse Events
   The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

With best wishes for the research.

Yours sincerely

Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc: Jennifer Hall

UCL Research Ethics Committee, c/o The Graduate School, North Cloisters, Wilkins Building
University College London Gower Street London WC1E 6BT
Tel: +44 (0)20 7679 7844 Fax: +44 (0)20 7679 7043
ethics@ucl.ac.uk
www.ucl.ac.uk/gradschool

Appendix D Other pregnancy intention questions used

Survey name	Pregnancy intention questions on survey
National Natality Survey 1963 – 1980, became the National Maternal and Infant Health Survey (NMIHS) 1988, 1996	(1968 and 1969): Just before you became pregnant with your new baby, did you want to become pregnant at that time? a) Yes. b) No, wanted a baby, but did not want to become pregnant yet. c) No, did not want a baby. (After 1972): Thinking back, just before you became pregnant with your new baby, did you want to become pregnant at that time? a) I wanted this pregnancy at an earlier time as well as at that time. b) I wanted to become pregnant at that time. c) I did not want to become pregnant at that time but wanted another child sometime in the future. d) I did not want to become pregnant at that time or at any other time in the future.
Surveys of Young Women 1970s	1) Did you want to become pregnant the (first, second, third, fourth) time?
National Longitudinal Survey of Youth (NLSY) from 1979, pregnancy questions since 1982	Before you became pregnant last time, did you want to become pregnant when you did? 1) Yes 2) If no, did you want a(nother) baby but not at that time or did you want none at all? a) didn't matter b) no, not at that time c) no, none at all d) don't know
Early Childhood Longitudinal Study (ECLS) 2001	At the time that you/your partner became pregnant with your baby, did you yourself actually want to have a(nother) baby at some time? Did you/your partner become pregnant sooner than you wanted, later than you wanted to at about the right time?

Appendix E EMBASE search strategy for UIP and LBW

1 "post natal depression".mp. (167)
2 post natal depression.mp. (167)
3 PND.mp. (4232)
4 post partum depression.mp. (271)
5 postnatal depression.mp. (3008)
6 postpartum depression.mp. (2829)
7 puerperal depression.mp. (6477)
8 (postnatal adj4 depression).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (3118)
9 (postpartum adj4 depression).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (3194)
10 (puerper* adj4 depression).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (7687)
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (12843)
12 unwanted pregnancy.mp. or unwanted pregnancy/ (3323)
13 "pregnancy intention*".mp. (337)
14 "pregnancy intended*".mp. (35)
15 "unintended pregnancy".mp. (2003)
16 unplanned pregnancy.mp. or unplanned pregnancy/ (3366)
17 unwanted pregnan*.mp. (3822)
18 "pregnancy attitude*".mp. (51)
19 unintended childbearing.mp. (22)
20 unintended fertility.mp. (11)
21 "unintended pregnanc*".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (2729)
22 "mistim* pregnan*".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (55)
23 "pregnan* mistim*".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (3)
24 "unwanted child*".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (140)
25 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 (8324)
26 11 and 25 (163)
27 birth weight.mp. or birth weight/ (88931)
28 low birth weight.mp. or low birth weight/ (40585)
29 birthweight.mp. (14369)
30 27 or 28 or 29 (91853)
31 pregnancy outcome/ (32691)
32 miscarriage.mp. or spontaneous abortion/ (30028)
33 pregnancy loss.mp. (5948)

34 stillbirth.mp. or stillbirth/ (12235)
35 neonatal mortality.mp. or newborn mortality/ (12029)
36 neonatal death.mp. or newborn death/ (7405)
37 11 or 30 or 31 or 32 or 33 or 34 or 35 or 36 (173585)
38 25 and 37 (907)

Appendix F Characteristics of studies found in the literature review on miscarriage, stillbirth and neonatal death

First author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Result for miscarriage	Result for still-birth	Result for neonatal death	Result for post-neonatal mortality	Result for infant mortality	Result for child mortality	Limitations / comments
Dawen, 2014. Data collected: unknown. UK (HIC)	Women presenting to an early pregnancy unit in London over three years (4139)	Retrospective observational cohort study of pregnant women who had documentation of outcome and whether the pregnancy was planned or unplanned	Question not included. Antenatal	35.9%	No difference (40.5% versus 42.5%)						Limited information as only an abstract, no raw data so can't calculate OR; not even clear which way round the percentages are.
Wellings, 2013. Data collected: 2010-12. UK (HIC)	A nationally representative sample of 15 162 men and women aged 16–74 years, looked at women aged 15-44 who had a pregnancy in the last year (5686)	Cross-sectional survey	London Measure of Unplanned Pregnancy. <12 months postnatally	16.2% unplanned 29% ambivalent	No significant difference on univariate analysis (unplanned 33.6%, planned 35.3%)						Used LMUP but dichotomised and did so at unusual cut-point. Retrospective, cross-sectional data. No adjusted analysis presented.
Singh, 2013. Data collected: 1998-2003. India (LMIC)	Currently married women aged in 15-39 in 4 states in 2002-3 who had been interviewed in the National Family Health Survey in 1998-9 were re-interviewed (2108)	Surveys completed at the two time points and asking about the time in between	Fertility intentions in non-pregnant women: Would you like to have (a/nother) child or would you prefer not to have any more children? How long would you like to wait from now before the birth of (a/nother) child? For pregnant women: DHS question. Pre-conception.	49.0%			adjusted OR 1.83 (1.01, 3.34)		aOR 1.52 (0.95, 2.45)		Only currently married women, limited age range. Asked about future fertility intentions and used this to assign wantedness to future pregnancies, without recognising that this could have changed. Excluded women who were 'unsure'. Pregnancies that did not result in a live birth were not included.
Assefa, 2012. Data collected: 2009-10. Ethiopia (LIC)	Women who became pregnant in one of 12 kebeles during the study period	Women visited every 3 months and tested for pregnancy, then visited monthly to determine pregnancy outcome	Question not included. Antenatal	31.8%	crude HR 3.0 (2.15, 4.15), adjusted HR 2.2 (1.56, 3.11)						Will have missed some early miscarriages, but this should be minimal. Can't differentiate between miscarriage, abortion and stillbirth so all combined into pregnancy loss.
Singh, 2012. Data collected: 2005-6. India (LMIC)	A nationally representative sample of 124 385 women aged 15-49 (51555)	Cross-sectional survey	DHS question, <12 months postnatally	20.3%			aOR mistimed 1.82 (1.16, 2.84), aOR unwanted 2.22 (1.17, 4.24)	aOR mistimed 2.60 (1.07, 6.76), aOR unwanted 3.64 (1.39, 9.51)		aOR mistimed 1.37 (0.48, 3.89), aOR unwanted 5.92 (1.48, 23.7)	Retrospective DHS style questions, up to five years after the birth. Only live births included. 'Child' mortality actually 12-35 months.

First author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Result for miscarriage	Result for still-birth	Result for neonatal death	Result for post-neonatal mortality	Result for infant mortality	Result for child mortality	Limitations / comments
Chalasani, 2007. Data collected: 1982-2002. Bangladesh (LIC)	Women in the Sample Registration System in the Jessore and Sirajgonj districts (3283)	Baseline and quarterly surveillance from 1982-2002	Women were asked prospective preferences about how many further children they wanted of each sex; subsequent births were then categorised as wanted, "up to God", and unwanted. Pre-conception	41.0%			Adjusted OR 2.09 (p<0.001)	Adjusted OR 2.00 (p<0.001)		Deaths from 12-60 months. Adjusted OR 1.38	
Bustan, 1994. Data collected: 1959-1966. USA (HIC)	Pregnancies in women who were members of the Kaiser Health Plan in the East Bay Area of San Francisco (20754)	Women recruited on confirmation of pregnancy, interviewed and data extracted from medical records	Wording of question not included but asked about the attitude of the woman and her partner to the pregnancy. Antenatal	14.4%	crude RR 1.4 (1.0, 1.8), adjusted RR 1.1 (0.9,1.5)		crude RR 2.7 (1.8, 4.3), adjusted RR 2.4 (1.5, 4.0)	crude RR 0.8 (0.4, 1.9), adjusted RR 0.9 (0.5,1.9)			Excluded unmarried women and those who said that their attitude to the pregnancy was different to their husbands. Also women who had access to this health care plan - suggests low-risk population raising issues of representativeness
Laukaran, 1980. Data collected: 1958-1967. USA (HIC)	Women enrolled in the child health and development studies who were a member of the Kaiser Foundation Health Plan in the San Francisco East Bay Area (12391)	Utilises data from the Child Health and Development studies. Ever-married women receiving antenatal care at KFH. Outcome data from medical records.	How do you feel about having a baby now?' Antenatal	6.2% strong negative attitude		The relative risk (RR) adjusted for parity and husband's occupation was 1.80 (p = 0.003) and adjusted for mother's age and parity was 1.78 (p = 0.002)					Prospective study but measure of intention not comparable. Analysis only conducted on ever-married white women and only controlled for a couple of confounders

Appendix G Characteristics of studies found in the literature review on low birthweight

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Kost, 2015, USA	Non-multiple live births in three years preceding the interview (4184)	Analysis of pooled NSFG data from 2 survey rounds	NSFG question plus How much later did you want to become pregnant? And a multi-dimensional measure assessing trying, wanting and happiness. Postnatal mixed	30%	LBW <2500	Age, SES, marital status, education, parity, ethnicity, health insurance	**6% intended, 12% UIP, p<0.05**	**Not able to calculate /compare results presented**	Retrospective, recall, live births only, but large, representative survey. Strong analytic methodology	Yes
Wado, 2014, Ethiopia	Community-based cohort of pregnant women in 11 kebeles in south-western Ethiopia (537)	Interview during pregnancy with follow up within 72 hrs to of birth to weigh the baby	DHS question. Plus questions about happiness with pregnancy. Antenatal	41%	LBW <2500	Age, education, SES, MUAC, AND, social support	**OR 2.31 (1.25, 4.27)**	**RR 1.25 (0.73, 2.14) for mistimed, RR 2.08 (1.02, 4.23) for unwanted**	Excluded stillbirths and neonatal deaths	Yes
Lindberg 2014, USA	Women who delivered live births in Oklahoma between 2004-8 and completed a follow-up survey in 2006-10 (8327)	Analysis of PRAMS data (self-administered cross-sectional survey) for Oklahoma linked to 2 yr follow up survey	PRAMS question plus How much later did you want to become pregnant? Postnatal 1-6 months	49%	LBW <2500	Age, SES, marital status, education, parity, ethnicity, smoking/alcohol, health insurance	**8% in UIP, 7% in IP, p<0.05**	**OR 1.19 (0.93, 1.53) unwanted, 0.85 (0.70, 1.02) for mistimed >2yrs, 0.95 (0.80, 1.12) mistimed <2 yrs**	Retrospective, recall, live births only, but large, representative survey.	Yes
Kayode, 2014, Ghana	Women in 2003 / 2008 DHS who had given birth (5013)	Analysis of DHS data	DHS questions. Postnatal mixed	30.6%	LBW <2500	None	**18% in UIP, 16% in IP, no sig test**	**-**	DHS style questions and methods, analysis is focused on LBW so no data on confounding of UIP	Yes
Saedi, 2013, Iran	Unclear	Unclear	Unclear.	28%	LBW <2500	Not clear	**8.5% in unwanted, 11% in wanted, not sig**	**-**	Too little information on methodology, poor quality	No
McCrory, 2013, Ireland	Children aged 9 months between Sept 2008-April 2009 (11134)	Weighted sample from Child Benefit Register, 64.5% response rate, about 25% of all births. Families interviewed in person and CASI at 9 months	Wording not clear but 'asked the mother whether she intended to become pregnant before the study child was conceived'. Postnatal 7-12 months	41%	LBW <2500	Age, SES, marital status, education, parity, ethnicity, smoking, ANC	**OR 1.11 (0.94, 1.31)**	**RR 1.01 (0.83, 1.22)**	Retrospective, recall, live births only, but large, nationally representative survey. Mixed up categories of intention	Yes

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Flower, 2013, UK	Singleton babies born in UK in 2000-01 (18178)	Analysis of Millennium Cohort Study data	Were you planning to get pregnant or was it a surprise? Postnatal 7-12 months	43%	LBW <2500	Age, SES, marital status	**5.2% in planned, 7.2% in UIP**	**OR 1.24 (1.04, 1.48)**	Adjusted 1.24. Retrospective, recall, live births and singletons only, but large, nationally representative survey	Yes
Flores 2010 USA	Utah women delivering single live birth >20 weeks gestation (190948)	Analysis of PRAMS data for Utah, linked to birth certificates	PRAMS question. Postnatal 1-6 months	39%	LBW <2500	None	**In some ethnic groups, women with UIP were significantly more likely to have a LBW**	-	Abstract only so can't make a thorough assessment but using PRAMS data, which from other papers appears to be good. Most comparisons are between different ethnicities.	No
Postlethwaite 2010 USA	Women insured with Kaiser Permanante (1671)	Retrospective medical record review of women receiving their first ANC visit at one of the KP obstetric offices in 2002, random sample of 400 taken from each clinic, 2400 records reviewed.	At the time that you conceived, did you want to become pregnant (intended vs. unintended), did you want to become pregnant but not at this time (mistimed), or did you not want to become pregnant at all (unwanted)? . Antenatal	37.8%	SFGA	None	**4.8% unwanted, 2.3% intended, says not sig**	-	All women had a KP pre-paid health plan and access to ANC. They had earlier initiation of ANC than nationally (88-89% v 84%), lower levels on UIP (37.8% v 49% p<0.0001) and low levels of SFGA (3.37%) - suggests that this is an advantaged population. SFGA only, data not comparable	No
Iranfar 2009 Iran	Women on the postnatal ward at Kermanshah maternity hospital (114)	Case-control study on postnatal ward	Questions on birth control method and stopping time, planning for pregnancy and tendency to abortion. Postnatal <1 month	47%	BW <3000g and average birthweight	None	**35.7% in UIP, 27% in IP, p=0.51**	-	Cases should have been those with low birthweight, not those with UIP. Measure of intention not clear - seems to be that it was assumed to be UIP if the woman had been using contraception. Presents <3000g so not comparable data	No
Hohmann-Marriott 2009 USA	Participants of the Early Childhood Longitudinal Study (ECLS) birth cohort where biological father resident at 9 months (5788)	Analysis of couple level data from interviews at 9 months in the ECLS on conception, pregnancy and birth, linked with birth certificate data	At the time that you/your partner became pregnant with your baby, did you yourself actually want to have a(nother) baby at some time? Did you/your partner become pregnant sooner than you wanted, later than you wanted to at about the right time? Postnatal 7-12 months	Can't do	LBW <2500		**OR 1.36, no 95%CI given, says not sig**	**No data**	Inclusion criteria of father resident at 9 months will bias the results to the null because fathers of UIPs are less likely to be living with the child at 9 months than fathers of IP. Data presented on couple intentions is incorrect. Can't extract numbers to calculate ORs. Presented OR is mother only - not comparable - would need TO be combination of mother only and both v father only and neither but data not available	No

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Shaheen 2007 Egypt	Ever married women in the Demographic and Health Survey (DHS) (2379)	Analysis of DHS data	DHS question. Postnatal 7-12 months	18%	Women's assessment of size	Age Parity	**UIP more likely to report smaller than average size OR 1.34 (1.02, 1.76)**	-	Outcome assessed by women's report of size - subjective. Only married women and only live births therefore underestimates UIP rate.	No
Mohllajee 2007 USA	Women who gave birth in 18 states in 1996-9, multiple births excluded (87087)	Analysis of PRAMS data for 18 states linked to birth certificates	PRAMS questions. Postnatal 1-6 months	47%	LBW <2500 and LBW<10%	Age Parity Marital status Education Smoking / alcohol ANC Previous LBW / PTB	**6.8% UIP, 5% IP, p<0.01**	**OR 1.06 (0.97, 1.16) unwanted, OR 0.92 (0.86, 0.97) mistimed, OR 1.15 (1.02, 1.29) ambivalent**	Retrospective, recall, live births only	Yes
Collier 2006 USA	Women who gave birth in Georgia in 1996-7 (211716)	Analysis of PRAMS data) for Georgia linked to birth certificates	PRAMS questions. Postnatal 1-6 months	63%	LBW <2500	None	**RR 1.37 (1.08, 1.72)**	-	Retrospective, recall, live births only	Yes
Rafati 2005 Iran	Births in 2 hospitals in Tehran (460)	Case-control study on postnatal ward - cases = LBW, controls = 2 babies >2500g born consecutively after each case. Neonates with complications excluded	Unclear. Postnatal <1 month	3%	LBW <2500 and average birthweight	None	**In LBW babies 6% were UIP, in normal birthweight 1% were UIP, p<0.001**	-	Measure of intention not described	No
D'Angelo 2004 USA	15 states (25027)	Analysis of PRAMS data for 15 states linked to birth certificates	PRAMS questions. Postnatal 1-6 months	43%	LBW <2500	None	**9.6% in unwanted, 6.5% in wanted, p<0.001**	-	Retrospective, recall, live births only	Yes
Durousseau 2003 USA	California, term births to >15 yo during February to May 1999 and from February to May 2000 Inc. twins and triplets (5941)	Uses California's Maternal Infant Health Assessment (MIHA) an annual population-based self-administered mail survey with telephone follow up for non-responders that collects information about pregnancy-related conditions and behaviours.	Question about whether before pregnancy the mother wanted to get pregnant then, later, or not at all or was unsure, respectively plus her initial happiness about becoming pregnant on a five point Likert scale of: very happy; somewhat happy; somewhat unhappy; very unhappy; and unsure. Postnatal 1-6 months	47%	SFGA	Age Education Ethnicity Smoking Previous LBW / PTB	**OR 1.2 (0.6, 2.3)**	**No data but says non-significant relationship**	Retrospective, recall, live births only. Sample only includes over 15, English and Spanish speaking women. Only those giving birth in Feb-May each year	No

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Pulley 2002 USA	1995 National Survey of Family Growth (NSFG) women with a single live birth in the last 5 years (4120)	Included all pregnancies reported in the 1995 NSFG ending in a live birth in the five years prior to the woman's interview. The 1995 version of the intendedness questions was used and all women were asked how happy they were when they learned they were pregnant.	NSFG question: plus a 10-point scale measuring happiness about a pregnancy. Postnatal mixed	31%	LBW <2500	Marital status Age Education Parity SEC Ethnicity	**6% unwanted, 5.1% intended, says not sig**	-	Retrospective, recall, live births only	Yes
Korenman 2002 USA	Women in the National Longitudinal Survey of Youth (NLSY) who had at least one birth after 1978 (7800)	Uses data from the 1979-1992 NLSY from women who had at least one birth after 1978.	Four questions about pregnancy intention described as similar to those in the NSFG but not specified. Postnatal mixed	37%	LBW <2500	None	**10.4% mother only intended, 7% if both intended**	**No data**	Mostly focused on comparisons of intention between the partners. Uses models that attempt to account for uncontrolled confounding factors through within family comparisons on intended and unintended births.	Yes
Ahluwalia 2001 USA	13 states women with singleton births (15219)	Analysis of PRAMS data for 13 states linked to birth certificates	PRAMS questions. Postnatal 1-6 months	45%	SFGA	None	**OR 1.25 (0.99, 1.58)**	-	Retrospective, recall, live births only. SFGA data only, not comparable	No
Eggleston 2001 Ecuador	DHS (2490)	Subsample of the DHS	DHS questions. Postnatal >12 months		Women's assessment of size and LBW <2500	ANC Smoking Alcohol consumption Age Parity rural v urban Education	**OR 1.64 (1.22, 2.20)**	**Unwanted OR 1.64 (1.22, 2.20), mistimed OR1.18 (0.88, 1.60)**	Uses mother's assessment of size for outcome, as well as numeric answer if that was available. Had to exclude a large number of women who did not report their infant's weight - these women may be more likely to have characteristics associated with LBW and therefore would lead to an underestimate	No
Joyce 2000 USA	Women in cohort giving birth between 1979 and 1992 (7751)	National Longitudinal Survey of Labor Market Experience, a probability sample of young adults between the ages of 14 and 21 in 1979, the first year of the survey. Respondents are interviewed annually. Have sibling data so can compare intendedness within families	Four questions about pregnancy intention described as similar to those in the NSFG but not specified. Postnatal mixed	44%	LBW <2500	None	**11.6% in unwanted, 6.4% in intended, no sig test**	**Only effect sizes presented so not able to compare**	Multiple models with different control groups and confounders. Uses mother's report of birthweight, says that there are high rates of agreement between this and vital records.	Yes

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Sable 2000 USA	Missouri live singleton births between Dec 1 1989 and Mar 31 1991 (2378)	National Institute of Child Health and Human Development / Missouri Maternal and Infant Health Survey, a population based case control study. Cases were vLBW, matched with 2 controls next births - one LBW and one NBW, identified from birth certificate data	NSFG questions. Postnatal mixed	57.9%	LBW <2500 and vLBW	None	**0R 0.90 (0.74, 1.10) for moderately LBW (1500-2499) v normal**	-	Mixed methods of data collection and variable time to data collection. Retrospective, recall. Weights compared differently to other studies; vLBW v normal and moderate LBW v normal so not comparable.	No
Colley 1999 USA	Mothers who had a live-born infant in the 13 included states in 1997	Analysis of PRAMS data for 18 states linked to birth certificates	PRAMS questions. Postnatal 1-6 months	33-59%	LBW <2500	None	**No data but says no differences in LBW by intention**	-	Methods robust but some repeated data from other PRAMS studies in the same states and same year. Also no data presented to enable a calculation.	No
Fourn 1999 Benin	Women attending ANC in Cotonou hospital (4113)	Used a questionnaire at first ANC to gather socio-demographic data, obstetric history. Followed up through pregnancy and complications such as bleeding and malaria were recorded.	Women were asked at the first visit if the pregnancy was wanted or unwanted. Antenatal	17%	LBW <2500	Pregnancy complications Age Parity	**13% unwanted in NBW, 21.7% unwanted in LBW**	**OR 1.6 (1.30, 2.00)**	Only women attending ANC at the hospital, but they say that about 90% of the local population access this. Not entirely clear what is adjusted for in the analysis.	Yes
Kost 1998 USA	NMHIS women aged 15-49 in 48 states who had a live birth in 1988 or NSFG nationally representative sample of women aged 15-44 who gave birth between 1984-88 (11585)	Data from national maternal and infant health survey and the national survey of family growth, NMHIS postal questionnaire, women aged 15-49 in 48 states who had a live birth in 1988. NSFG interviews with nationally representative sample of women aged 15-44 who gave birth between 1984-88, birth certificates	NSFG questions. Postnatal mixed	n/a	LBW <2500 and LBW <10%	None	**LBW more common in unwanted (9.7%) and mistimed (6.5%) pregnancies than intended pregnancies (5.1%), p<0.05**	-	Can't calculate odds ratio as numeric data not presented. Lots of interesting data from the regression models. Importance of planning for early recognition of pregnancy and timely ANC	No
Mitchell 1997 USA	Participants included women who had a live birth, a stillbirth, or an infant death in 1988 (18000)	1988 NMIHS data and presentation of other analyses of the 1982-88 NSFG data. The women completed a 40-minute mailed questionnaire regarding prenatal care, health habits, and pregnancy outcomes.	NSFG questions. Postnatal mixed	40%	LBW <2500	None	**10.8% in unwanted, 6.7% in wanted, says sig**	-	Retrospective, recall, live births only	Yes

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Bitto 1997 Chile, Italy, Columbia, USA	All women in the study who became pregnant between Jan1987 and Sept 1990 in the 5 centres (656)	Sub-study of a multicentre international prospective cohort study of women using natural family planning methods designed to ascertain the effects of timing of conception on pregnancy outcome. Intention determined on recognition of pregnancy, followed up at 16 and 32 weeks and after delivery.	Women asked at time pregnancy recognised whether the pregnancy had been planned. Validated by natural family planning instructor after talking to woman and reviewing her chart and independently reviewed. Defined as planned if women stated it was her intention to become pregnant and her chart showed intercourse during her fertile period. Antenatal	51%	LBW <2500 and average birthweight	Age pregnancy complications BMI Smoking / alcohol Parity Previous LBW / PTB infant sex	**OR 0.69 (0.30, 1.58)**	**OR 0.90 (0.24, 3.44)**	Users of natural family planning - not representative of a wider population - Doesn't present results by centre despite stating that they were very different - Chile had 37-40% unplanned pregnancies; DC had <2% - seems like very different populations, only have one OR for all data	No
Bustan, 1994, USA	Pregnancies in women who were members of the Kaiser Health Plan in the East Bay Area of San Francisco (20754)	Women recruited on confirmation of pregnancy, interviewed and data extracted from medical records	Wording of question not included but asked about the attitude of the woman and her partner to the pregnancy. Antenatal	14.4%	LBW <2500	None	**Not presented and no raw data**	**OR 1.72 (1.08, 2.76)**	Excluded unmarried women and those who said that their attitude to the pregnancy was different to their husbands. Excluded those with missing data on intention or who were not interviewed during pregnancy, and selected one pregnancy per women reduced the sample size to 8823 from over 20 000, also women who had access to this health care plan - suggests that these women were at less risk of UIP and of adverse outcomes raising issues of representativeness	No
Sharma 1994 USA	High risk inner city women with a live birth between 1989-91 in one of six geographical areas (1004)	Telephone interviews of 1004 women of childbearing ages (15 to 44 years), selected through random digit dialling procedure.	Exact questions not presented but based on PRAMS and MIHS. Postnatal mixed	54%	LBW <2500	Age Marital status Education Ethnicity SEC maternal conditions Previous abortion	**1.1 (0.9-1.4) according to paper, no raw data given**	-	Selected high-risk populations, excludes those without telephones who are likely to be more disadvantaged. Live births only. Don't present data, only adjusted OR and it isn't clear what was included in the model.	No
Gadow 1991 Argentina (9), Bolivia (1), Brazil (4), Chile (1), Colombia (2) and Venezuela (1)	5155 normal women having normal offspring in 18 maternity hospitals participating in the ECLAMC in 1992-4 (5155)	As the control group of a south American study on malformations 5155 normal women having normal offspring were interviewed during the post-partum period in 18 maternity hospitals participating in the ECLAMC. This data is analysed here.	(i) if this gestation was intended or not; and (ii) if contraceptive methods were used or not. . Postnatal <1 month	50%	Average birthweight	Age Education Parity Ethnicity	**No differences in average birthweight, but raw data nor presented**	-	Multi-centre study with results presented as aggregate may mask differences at country level. Retrospective but closer to delivery. Only live births. Slightly difference measure of intention. Only presents average birthweight.	No

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Poland 1990 USA	200 poor, mainly black women who delivered at the Hutzel Hospital in Detroit over a 26 month period (200)	Interview and review of medical records	Initial attitude to pregnancy recorded as mixed, negative or positive. Time delay before telling second person about the pregnancy. Postnatal <1 month	50%	LBW <2500	None	**Attitude to pregnancy contributes to variation in prenatal care which contributes to 26% of the variation in birthweight**	-	Develops a model to assess the contribution of different factors to LBW. Doesn't quantify difference in LBW between intention groups. Intention not robustly assessed and not comparable to others.	No
Cartwright 1988 UK	Random sample of women with live births that year in 10 areas in England (1486)	Sub-study of a methodological study to assess the feasibility of monitoring maternity services through postal questionnaires. Random sample of births in each area (areas chosen systematically with a random starting point and with probability proportional to the number of births in 1982) in one month in 1984. Postal questionnaires sent about 4 months after birth with up to two reminders.	'When you first found you were pregnant, how did you feel about it then? Would you rather it had happened a bit later or were you pleased you were pregnant then, or sorry it had happened at all?' 'Around the time you became pregnant were you or your husband or partner generally using any method of birth control? 'So would you say you intended to become pregnant or not? Stated intentions used in the analysis. Postnatal 1-6 months	27%	LBW <2500	None	**Decreasing proportion of unintended pregnancies as birthweight increases**	-	Retrospective, live births but comment on all conceptions. Measure of intention not standardised but similar to others.	Yes
Marsiglio 1988 USA	6,015 women in the NLSY who were interviewed in 1984 and who had had one child (1581)	Uses data from the 1979-1992 National Longitudinal Survey of Youth (NLSY) from women who had at least one birth after 1978.	'Was the reason you (were not/stopped) using any contraceptive methods because you yourself wanted to become pregnant?' Respondents could answer 'yes' or 'no.' Those who answered 'no' were then asked, 'Just before you became pregnant did you want to become pregnant when you did?' if 'no', 'Did you want a baby but not at that time, or did you want none at all?'. Postnatal mixed	45%	LBW <2500	Age Ethnicity	**7.9% in unwanted, 6.1% in wanted, says not sig**	**Can't calculate but says not significant**	Looking at direct and indirect relationships between intention and LBW through antenatal behaviours. Does multivariate regression.	Yes

Author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Proportion of UIPs	Measure of birth weight	Confounders controlled for	Result for LBW, unadjusted	Result for LBW, adjusted	Limitations / comments	In meta-analysis
Pamuk 1988 USA	Women aged 15-44 in the USA 7969	Data from the NFSG 1982 survey. Personal interviews were conducted with a multistage area probability sample of 7,969 women 15-44 years of age. Women were eligible for interview regardless of their marital status.	NSFG questions. Postnatal mixed	40%	LBW <2500	None	**No data but says no differences were noted in LBW by intention**	-	Retrospective, live births only.	No
McCormick 1987 USA	Low income women in central Harlem (458)	Women attending for ANC at Harlem Hospital and affiliated clinics completed a questionnaire covering socio-demographics, attitude to child, health behaviours and exposure to stressful events	A series of questions on attitude to the pregnancy including 'Did you plan this pregnancy?' and whether they were surprised at being pregnant. Antenatal	73%	LBW <2500	None	**No data but says no differences were noted in LBW by intention**	-	No data presented so can't calculate, says no relationship between planning and LBW / PTB. A group of low-income urban women, not many differences between planned and unplanned on soc-demog charac or behaviours therefore no differences in outcomes not so surprising. Only presents data on women who attended for ANC	No
Laukaran 1980 USA	Ever married women who were a member of the Kaiser Foundation Health Plan in the San Francisco (12391)	Utilises data from the Child Health and Development studies to conduct a prospective analysis of maternal attitude in relationship to events during pregnancy and delivery and pregnancy outcomes. Outcome data from medical records.	How do you feel about having a baby now?' 7 options divided into 4 categories of attitude and then pregnancy divided into wanted if there was a strong favourable response and unwanted if there was a negative response; middle responses were excluded. Antenatal	28.20%	LBW <2500	None	**No data but says no differences were noted in LBW by intention**	-	Prospective study but measure of intention not comparable, only compares two extremes and middle section ignored. No data presented so can't calculate - just says that no relationship between attitude and LBW.	No
Morris 1977 USA	Random selection of women giving birth in one of the hospitals included in the Family Planning evaluation (7921)	Interview on the postnatal ward of a random selection of women with live births in 60 hospitals in 17 major cities	Just before you became pregnant this time, did you: 1. want to become pregnant, 2. want a(nother) baby, but didn't want to become pregnant yet, or 3. not want a(nother) baby? (Go to Q. 9b) 4. didn't matter. 9b. At the time you became pregnant, did you feel 1. you would want a(nother) baby some time later 2. you would never want a(nother) baby?. Postnatal <1 month	22.1% in blacks, 10.9% in whites	LBW <2500	Stratified analyses by education, parity, marital status	**6.6% in unwanted, 4.3% in wanted in whites (p<0.05), 10.1% in unwanted, 9% unwanted in blacks, not sig**	-	Retrospective, but very near to birth so less potential for recall bias, live births only	Yes

Appendix H Characteristics of studies found in the literature review on postnatal depression

First author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Measure of depression and timing of assessment	Proportion of UIPs	Prevalence of PND	Result for PND, unadjusted	Result for PND, adjusted	Limitations / comments
Patel 2002 India LMIC	Women attending Asilo hospital antenatal clinic in their third trimester (270)	Prospective cohort study: consecutive women were interviewed in pregnancy, at 6-8 weeks (93%) and at 6 months postpartum (87%)	Question wording not clear, just 'whether it was planned'. Antenatal	EPDS cut off 11/12. 6-8 weeks and 6 months	29%	23% at 6 weeks, 22% at 6 months	RR 0.3 (0.2-0.5)	OR 0.3 p=0.007	Prospective study using a validated measure of depression, probably representative given high uptake of ANC and low LTFU. Measure of intention not clear and no raw data presented to allow calculations. **Estimates presented for planned pregnancy not unplanned pregnancies so are the other way round to the rest.**
Fisher 2004 Vietnam LMIC	Women attending the Hung Vuong O&G hospital or MCH&FP centre in Ho Cho Minh City at 6-8 weeks postpartum (506)	Cross-sectional interview-administered survey of consecutive attendees at the postpartum check	Question wording not clear, categories: 'welcome' or 'unwelcome' pregnancy. Postnatal 1-6 months	EPDS cut off 12/13. 6-8 weeks	28.6%	33%	p<0.001	OR 2.3 (1.6, 3.3)	Cross-sectional study using a validated measure of depression, probably representative given high uptake of ANC and low LTFU. Measure of intention not clear but seems slightly different (welcome rather than intended). Cross-sectional, doesn't look at antenatal depression, violence or gender preference which are important in this setting
Agoub 2005 Morocco LMIC	All women who gave birth in January and February 1999 in the catchment area of an MCH unit in a primary health care setting in Casablanca (144)	Women were recruited at first postnatal visit (2-3 weeks) and reassessed at week 6 and months 6 and 9.	Question wording not clear but analysed both 'planned' and 'wanted'. Postnatal <1 month	Mini International Neuropsychiatric Interview (MINI). 2-3 weeks, 6 weeks, 6 month, 9 months	21.6% unwanted, 42.4% unplanned	18.7% at 2-3 weeks, 6.9% at 6 weeks, 11.8% at 6 months, 5.6% at 9 months	OR 0.92 (0.39, 2.16)	-	Prospective study using a validated measure of depression, but this is diagnostic not screening so will pick up lower rates than other studies. Measure of intention not clear, done postnatally and both 'planned' and 'wanted' are reported separately. Quite a small study so lack of significance maybe due to this as socio-demographic factors were also non-significant. Representativeness of the population is not clear.
Nakku 2006 Uganda LIC	Women attending for out-patient postnatal services a peri-urban primary health care centre on the outskirts of Kampala (523)	Cross-sectional interview-administered survey of consecutive attendees at the postpartum check	Question wording not clear. Postnatal 1-6 months	SRQ-25. 6 weeks	50.7%	7.3% on SRQ, 6.1% on MINI for major depression	11.94 (1.6, 6.85)	3.04 (1.51, 6.17)	May not be representative as uptake of postnatal care is very low in Uganda, particularly in more disadvantaged groups. Cross-sectional study using a validated measure of depression, including screening and diagnostic tools. Measure of intention not clear. One table says 258 pregnancies were not planned, the next that 258 were planned. The way the univariate analysis is presented planned pregnancies pose an increase PND risk (OR 12) but in multivariate unplanned pregnancies do (OR 3.05).

First author, year, location	Study population (size)	Methodology	Measure of intention and timing of assessment	Measure of depression and timing of assessment	Proportion of UIPs	Prevalence of PND	Result for PND, unadjusted	Result for PND, adjusted	Limitations / comments
Owoeye 2006 Nigeria LMIC	Women aged 15-45 delivering in Lagos Island Maternity Hospital in the 4 months of data collection (252)	Women were recruited and interviewed within 5 days of delivery, then followed up at 4-6 weeks	Question wording not clear. Postnatal <1 month	EPDS cut off 11/12. 4-6 weeks	20.2%	23.0%	OR 8.83 (4.45, 17.53)	-	May not be representative as recruitment based on hospital delivery. Cross-sectional study using a validated measure of depression. Measure of intention not clear. Raw data only presented for unplanned pregnancy so cannot calculate OR from this. No adjusted analysis.
Gausia 2009 Bangladesh LIC	Pregnant women in the Matlab Demographic Surveillance Site (346)	Pregnant women of 34-35 weeks gestation were identified from the Matlab database and were interviewed at home	Question wording not clear, just 'wanted or unwanted'. Antenatal	EPDS cut off 9/10. 6-8 weeks	29.0%	22.0%	RR 1.70 (1.14, 2.51)	OR 1.1 (0.5, 2.4)	Community-based with small LTFU so should be representative (though high prevalence of AND in those lost). Used validated measure, though lower cut-off. Measure of intention not clear but assessed in pregnancy. Antenatal depression and previous mental health illness included.
Ali 2009 Pakistan LMIC	Pregnant women living in two peri-urban communities in Karachi (267)	Pregnant women were identified via house-to-house survey and consented to participate after live birth	Question wording not clear. Postnatal <1 month	Aga Khan University Anxiety and Depression Scale, cut off 18/19. 1, 2, 6 and 12 months	81.6%	5.2% at 1+2 months, 10.1% at 6 months 13.1% at 12 months	p=0.017	OR 2.11 (1.04, 4.29)	Community-based but of 651 pregnant women identified 420 consented and 267 were followed to one year, a LTFU of 59%, so may not be representative. Not sure if pregnancy intention is reported correctly (>80% unplanned?). Doesn't include AND. Very locally specific measure of PND, not sure how generalizable this is.
Prost 2012 India LMIC	Women in the control arm of a cRCT evaluating the effect of women's groups on neonatal mortality and maternal distress. (5801)	Key informants notified births and women were interviewed at home around 6 weeks postpartum	Question wording not clear. Postnatal 1-6 months	K10, a screening tool for non-specific psychological distress, cut off 15/16. 6 weeks	11.3% unwanted by mother, 10.7% unwanted by father	12%	mother: OR 1.42 (1.10, 1.82), father: OR1.36 (1.05, 1.77)	Mother: OR 1.49 (1.12, 1.97). Live infant OR 1.96 (1.48, 2.58), No infant OR 0.41 (0.19,0.88)	Community-based large dataset including many confounders but not violence or antenatal depression. Measure of intention not clear and taken postnatally. Used a validated screening measure of depression but it was not used by any other studies. Also assessed partner's intention, though not clear if this was the mother's report. Analysis stratified by whether or not the infant was alive as there was interaction.
Saleh 2013 Egypt LMIC	Women delivering in Mansoura University Hospital between July 06 - Jan 07 (120)	Case control study of 60 patients with PND and 60 controls. Women were examined at 1 week, 1, 3 and 12 months by a psychiatrist and obstetrician. Of 379 patients 68 had PND, 8 declined to participate, healthy controls randomly selected.	Question wording not clear, asked about planning of pregnancy and attitude towards pregnancy. Postnatal 1-6 months	EPDS cut off 12/13 and psychiatric interview. 1, 3 and 12 months	19.2% unplanned, 17.5% unwanted	17.9%	OR 4.71 (1.62, 13.7)	-	Based on hospital recruitment; not stated how many women deliver in hospital so unclear whether this would be representative. Measure of intention not clear and taken postnatally. Used a diagnostic assessment of depression so should pick up lower rates than studies with screening measures. Looked at biological measures as well as the standard, but not at violence. Pregnancy intention different in the two groups (30% v 8.3%) says in the text that this is not statistically significant, but it is.

Appendix I Sample size calculation

Sample size calculation to look for a 25% difference in an outcome with an overall prevalence 15% (13.6% to 17.0%), where 41% are unintended pregnancies (the group with higher prevalence of outcome – group 2 in the calculations below) with 80% power. This calculation suggests a required sample size of 3737.

. sampsi 0.136 0.17, power(0.8) r(0.69)

Estimated sample size for two-sample comparison of proportions

Test Ho: p1 = p2, where p1 is the proportion in population 1 and p2 is the proportion in population 2
Assumptions:

alpha = 0.0500 (two-sided)
power = 0.8000
p1 = 0.1360
p2 = 0.1700
n2/n1 = 0.69

Estimated required sample sizes:

n1 = 2211
n2 = 1526

Total sample size 3737

Appendix J Training timetable

Week 1

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	10/02/2013	11/02/2013	12/02/2013	13/02/2013	14/02/2013	15/02/2013	16/02/2013
09:00 - 09:30		Arrival, registration.	Plan for the day. Questions	Plan for the day. Questions	Plan for the day. Questions	Plan for the day. Questions	
09:30 - 11:00		Welcome and introductions - JH & NM (?and TP)	Information sheets and consent forms - theory - JH & FM	Antenatal questionnaire - paper - JH & NM	Postnatal questionnaire - paper JH & NM	Split session - supervisors to learn how to use laptops to create wifi, data collectors to practice questionnaires on each other JH & NM & BS	Review of the week. Cover areas identified on Friday
11:00 - 11:15		Break					
11:15 - 12:45		Introduction to MaiMwana - NM and to research project - JH & NM	Information sheets and consent forms - practice - JH, FM & EK plus supervisors	Introduction to the smartphone and commcare app - JH & NM & BS	Postnatal questionnaire - paper JH & NM	Supervisors to observe data collectors completing questionnaires and practice downloading data from smartphones JH & NM & BS	Cover areas identified on Friday
12:45 - 13:45		Lunch					
13:45 - 15:15	Briefing session for supervisors - JH	What is pregnancy intention? JH & NM	What is depression? - JH & EK	Antenatal questionnaire - phone JH & NM & BS	Postnatal questionnaire - phone JH & NM & BS	Supervisors to observe data collectors completing questionnaires and practice downloading data from smartphones JH & NM & BS	End of week 1
15:15 - 15:30	Break						
15:30 - 17:00	Briefing session for supervisors - JH	LMUP questions JH & NM	SRQ / EPDS questions - JH & EK	Antenatal questionnaire - phone JH & NM & BS	Postnatal questionnaire - phone JH & NM & BS	Split session - data collectors to continue practicing questionnaires on each other, supervisors to learn how to download data JH & NM & BS	
17:00 - 17:30	Participants may start to arrive anytime from 3pm on the afternoon of Sunday 10th February	Summary of the day. Questions.	Summary of the day. Questions.	Summary of the day. Questions.	Summary of the day. Questions.	Summary of the day. Questions. What would people like to cover in the recap session?	

Week 2

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
	17/02/2012	18/02/2013	19/02/2013	20/02/2013	21/02/2013	22/02/2013
09:00 - 09:30		Review of last week, plan for this week. Questions.	Piloting - practicing questionnaires and anthropometry - HC, EK, NM & JH	Feedback from piloting - what went well, what didn't etc - use this to plan what we do today - JH, HC, EK & NM	Piloting - practicing questionnaires and anthropometry - HC, EK, NM & JH	Feedback from piloting - what went well, what didn't etc - use this to plan what we do today.
09:30 - 11:00		Anthopometrics - theory - HC, EK & JH				
11:00 - 11:15		Break		Break		Break
11:15 - 12:45		Anthopometrics - theory - HC, EK & JH		as above		as above
12:45 - 13:45		Lunch		Lunch		Lunch
13:45 - 15:15		Anthropometrics - practice - baby weight and length (on dolls) - HC, EK & JH		as above		Review of the week. Questions. Info for meetings on Sat / Mon. Plan for starting data collection
15:15 - 15:30		Break		Break		End of week 2 - participants return home
15:30 - 17:00	Possible session - TBC - Session for supervisors on identification of pregnant women and follow up. General discussion of any issues - JH	Anthropometrics - practice - mother MUAC and height (on each other) - HC, EK & JH		as above		
17:00 - 17:30		Summary of the day. Questions.		Summary of the day. Questions.		

Appendix K Postnatal refresher training timetable

	Sunday 28/04/2013	Monday 29/04/2013
08:00-09:00	Arrive and register	Anthropometrics - theory and practice - HC, EK
09:00 - 09:30		
09:30 - 10:00	Welcome, ground rules etc	
10:00 - 10:30	Review and feedback of antenatal data collection so far. Trouble shooting. JH, PK, RC, ED	Break 10:15 - 10:30
10:30-11:00		Practice postnatal interviews (groups of 3)
11:00 - 11:15	Break	
11:15 - 12:45	Postnatal questionnaire - paper - intro by JH on changes then work in zone groups	
12:45 - 13:45	Lunch	
13:45 - 14:45	Postnatal questionnaire - phone, inc how to locate and identify the correct woman, PN visit sheets	Practice postnatal interviews (groups of 3)
14:45 - 15:15		Review, recap of any difficulties identified, plans for data collection
15:15 - 15:30	Break	Summary of the day. Questions.
15:30 - 16:00	Postnatal questionnaire - phone (zone groups) and individual practice	
16:00 - 17:30		
17:30-18:00	Summary of the day. Questions.	

Global Health Action

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METHODS FORUM

Electronic data capture in a rural African setting: evaluating experiences with different systems in Malawi

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Background: As hardware for electronic data capture (EDC), such as smartphones or tablets, becomes cheaper and more widely available, the potential for using such hardware as data capture tools in routine healthcare and research is increasing.
Objective: We aim to highlight the advantages and disadvantages of four EDC systems being used simultaneously in rural Malawi: two for Android devices (CommCare and ODK Collect), one for PALM and Windows OS (Pendragon), and a custom-built application for Android (Mobile InterVA – MIVA).
Design: We report on the personal field and development experience of fieldworkers, project managers, and EDC system developers.
Results: Fieldworkers preferred using EDC to paper-based systems, although some struggled with the technology at first. Highlighted features include in-built skip patterns for all systems, and specifically the 'case' function that CommCare offers. MIVA as a standalone app required considerably more time and expertise than the other systems to create and could not be customised for our specific research needs; however, it facilitates standardised routine data collection. CommCare and ODK Collect both have user-friendly web-interfaces for form development and good technical support. CommCare requires Internet to build an application and download it to a device, whereas all steps can be done offline with ODK Collect, a desirable feature in low connectivity settings. Pendragon required more complex programming of logic, using a Microsoft Access application, and generally had less technical support. Start-up costs varied between systems, and all were considered more expensive than setting up a paper-based system; however running costs were generally low and therefore thought to be cost-effective over the course of our projects.
Conclusions: EDC offers many opportunities for efficient data collection, but brings some issues requiring consideration when designing a study; the decision of which hardware and software to use should be informed by the aim of data collection, budget, and local circumstances.

Keywords: *mHealth*; *electronic data capture*; *Sub-Saharan Africa*; *MIVA*; *ODK Collect*; *CommCare*; *Pendragon*

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Paper-based data collection methods have been standard in research and routine health settings for centuries. Advancements in mobile technology and its widespread availability have promoted the use of 'electronic data capture' (EDC). Although research to evaluate impact of mobile health interventions has been growing, publications are lacking on the use of mobile technology as a research instrument. The potential that mobile technology holds compared to a traditional paper-based process is an important area for investigation (1, 2).

EDC has several potential advantages, including: quicker turnaround time from field to analysis; improved data quality; in-built checking and consistency rules; and sophisticated automated skip patterns (1, 2). Additional hardware-dependent features such as Global Positioning System (GPS) and user-independent time-stamps can assist with monitoring work rate and data validation (3).

There are also potential limitations to EDC which need consideration such as data security, connectivity, and the need for field staff that are comfortable using the technology. Members of rural populations, from whom field staff are often recruited, are frequently not experienced with computer technology and may be put off trying to learn (4). This may be particularly relevant if

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field staff of a particular demographic are needed, although it can be seen as an opportunity for capacity building within communities. Mobile phones are valued items in resource-limited settings (5), which can lend status and respect to the research staff; however, the EDC device or research staff may be targeted for theft when working in the field (1).

As well as the rapid development of hardware, there are several software options available for EDC, and this is a key consideration. To choose an appropriate EDC method, context-specific factors such as infrastructure and the technical capacity of developers and fieldworkers need to be taken into account. As the use of EDC becomes more widespread in settings such as rural Sub-Saharan Africa, more researchers will be faced with choosing an appropriate EDC system.

We describe our experience with four EDC systems used simultaneously in rural Malawi (Table 1), highlighting key considerations for organisations considering EDC.

Context, setting, and method

All four EDC systems were used in Mchinji district, central Malawi, for research projects (March 2013 onwards), with a total of 64 devices being used in four different projects (Table 1). Mchinji has an estimated population of 500,000, 80% of whom live in rural communities where mobile phone ownership is approximately 35% (6).

CommCare was used in two prospective cohort research studies. The first investigated the relationships between pregnancy intentions and maternal and neonatal health. The second was investigating risks of treatment failure in community treatment of pneumonia in children. CommCare was chosen specifically for these two projects because of the 'case' function which allowed multiple interviews to be reliably linked, as well as the child's interviews to be linked to the mother's in the first project.

Pendragon was used in an evaluation of a health education radio programme on health knowledge and behaviours; our organisation already owned the personal digital assistants (PDAs) and given the benefits of EDC, we chose to use these over purchasing new hardware because of a limited budget. This may be a common situation in resource-poor settings, where organisations already own this out-of-date technology, and it is important to know how these fare against newer (more costly) hardware. Fieldworkers using Pendragon and CommCare were recruited from the local communities where they would be working for the duration of the projects. Most did not have experience of fieldwork or EDC technology and were required to have completed at least 4 years of secondary school, providing significant opportunities for capacity building.

ODK Collect and Mobile InterVA (MIVA) (7) were used together in a large-scale evaluation of vaccine introduction on post-neonatal infant mortality, to collect information on cause of death from verbal autopsies (VA). MIVA (which we have included to demonstrate a custom-built application) is a bespoke 'app' designed in collaboration with the World Health Organisation (WHO) to meet the pressing need for simpler VA data

Table 1. Summary of the electronic data capture software and hardware being used in Mchinji district, Malawi

	Software	Hardware	# of users	Project summary (duration)
Pendragon	Commercial, general purpose form design and administration system for Palm and Windows OS	PDA	12	Cross-sectional survey evaluating the impact of a health education radio programme (3 months)
CommCare	Open-source, but commercially supported, system with web-based form design, data management and reporting systems for Android	Android smartphone	44	Prospective cohort investigating pregnancy intention and maternal and neonatal health (18 months) Prospective cohort investigating risks of treatment failure in community-treated pneumonia (9 months)
ODK Collect	Open-source form design, mobile data collection and management system for Android	Android smartphone	8	Verbal autopsy interviews as part of a larger prospective cohort study to evaluate the impact of vaccine introduction on post-neonatal infant mortality (36 months – still ongoing)
MIVA	Purpose-built, stand-alone application for Android, to collect and process verbal autopsy data	Android smartphone	8	

OS: Operating System; PDA: personal digital assistant; ODK: Open Data Kit; MIVA: Mobile InterVA (www.interva.net).

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collection and processing, as a means to increasing the coverage of operational and representative cause of death registration systems (8). The app is built for android devices and is comprised of more than 200 questions, with skip patterns corresponding to the WHO 2012 standard VA tool. We used ODK Collect in conjunction with MIVA, as we wanted to collect additional information on socio-economic and vaccine status. MIVA could not be customised to collect additional information as it is a stand-alone phone application. Fieldworkers for this project were our most senior level of fieldworker, with all having more than 5 years' experience with the organisation, and had been awarded or were studying for diplomas, mostly in 'Community and Development'.

We asked all developers and project managers (between one and two) and at least five fieldworkers from each project to comment on their experiences using an open semi-structured questionnaire with regard to: technical support, and cost and ease of development (project managers and developers); and ease of use, data processing, and available features (all). Themes were synthesised from these responses, and added to from extensive personal field and development experience.

Development considerations

Ease of development

Development of the stand-alone MIVA application was done using an open-source development environment that could be programmed offline but required specialist programming knowledge and experience. The other EDC tools were developed by non-specialists having no previous experience to programming experts with more than 20 years' experience. ODK Collect and CommCare both have user-friendly web-interfaces for designing forms and programming simple logic, or can be developed offline by creating a spreadsheet describing the required form and allowing for more complex logic. However, CommCare requires an Internet connection to build the form and download it on to the smartphone. We found this dependence on the internet in a limited-connectivity setting to be a considerable limitation, e.g. updating forms in the field often took several attempts and considerably more time than doing it via USB. As a result, we would preferentially select ODK Collect over CommCare in studies not requiring multiple visits for this reason. Pendragon form design is done in Microsoft Access (requiring Microsoft Windows) and all logic has to be programmed using a proprietary scripting language.

Technical support

For the open-source products (ODK Collect and CommCare) good support is available on the Internet from both the developers and other users; specifically for CommCare, Dimagi (the product developer), also provides some support with relatively quick responses as standard, and additional support can be purchased for individual projects. For Pendragon, there is a user manual, but limited online support, which was generally not as easy to access as the open-source software. As MIVA is a standardised stand-alone 'app' it cannot be modified locally and therefore there is no technical support available beyond the specific user guide.

Cost

The two main initial costs are for the software and form development, and the hardware. These start-up costs were difficult to quantify for all projects, as some hardware (PDAs) was already available and the person-time spent creating, modifying, and maintaining the EDC tools varied from a few days for a simple form, to months and years for the more complicated systems. The smartphones we purchased all cost around 100 USD, and prices are likely to continue decreasing. Although the start-up costs were considered to be higher than a paper-based system, there is no data entry, or printing and photocopying costs for EDC. In the long term EDC is likely to be cheaper (as skills in form development increase, and hardware costs are written off), and perceived higher data quality makes it justifiable (9).

For on-going costs, because the majority of fieldworkers do not have electricity at home, they were given 7 USD/month to access commercial charging services. Solar chargers, which could be more cost effective in long-term projects and remove issues encountered when using commercial charging services, have been used successfully elsewhere (3). In our use of CommCare, data were uploaded to the server over cell phone Internet, incurring a total estimated cost of 30 USD/month. CommCare has a fee for more than 50 users (1 USD/additional user) or to access premium features (starting at 100 USD/month). Pendragon requires a one-off license fee (250 USD), with an additional fee (50 USD) for subsequent users. Compared to the running costs of a paper-based system, this is considerably less (e.g. for one data entry clerk and 500 multi-page questionnaires a month, the running cost of a paper-based system in our context would be 350 USD/month). The need for data cleaning is considerably reduced because of in-built cleaning rules, saving time and costs by reducing the need for field verification, and manual data checking and correcting.

Finally, there is the replacement of damaged, lost, or stolen hardware, including chargers, SD cards, and the devices themselves. Over 18 months of continuous data collection we have replaced 11 broken chargers, 2 batteries, 3 stolen SD cards, and 4 devices (out of 64), as well as repairing another device, which we did not consider to be unreasonable.

Implementation considerations

Ease of use

All fieldworkers preferred EDC to paper-based systems, one commenting that carrying paper-based systems can be tiresome, whereas the EDC is easier to carry, control, and work with. This is an important consideration when field workers in rural areas often cover large geographical areas, mostly by bicycle. The fieldworkers also commented that the technology was well accepted by respondents in the field.

One week's training was conducted jointly for MIVA and ODK Collect, in which fieldworkers were orientated on the project protocol; and introduced to smartphones and using the EDC tools. All project managers thought that this was enough time, although only half of the fieldworkers agreed. For CommCare both 1 and 2 weeks of training was conducted for different projects, and for Pendragon, 2 weeks training was provided; again all project managers thought this was sufficient time, but one-third of fieldworkers disagreed, even when training was 2 weeks. This may be due to financial (e.g. residential trainings provide meals and money for incidentals) or other benefits (e.g. certificates indicating the amount of training received). Furthermore, despite training sessions including mock-interviews, and in the case of CommCare, field test interviews, these are unlikely to cover every possible scenario or technical issue. As most fieldworkers subsequently faced a challenging interview or technical glitch, this may also explain why they thought more training was needed.

Despite the majority of fieldworkers never having used a smartphone or PDA previously, most became competent quickly, and an initial lack of familiarity does not seem to have been a barrier to adopting an EDC system. However, when using MIVA and ODK Collect simultaneously to capture different pieces of data in a single interview, the majority of fieldworkers found it difficult to switch between these two systems during the interview, even though these were senior fieldworkers. We found the inability to modify the pre-designed 'app' to be a major limitation in a research setting and have since decided to create a single form using ODK Collect.

Technical glitches such as forms freezing, forms not appearing, and difficulty in saving were encountered occasionally in all the EDC systems. No smartphone users reported problems with battery life or accessing and using commercial charging services; however more than half the fieldworkers using PDAs reported issues with poor battery life was an issue, unsurprising as the PDAs were second hand at the start of the project.

Features available

A summary of features available for each EDC system is presented in Table 2. Of particular note was the 'case' function in CommCare, allowing collected information from questionnaires to be stored on the smartphone and used in subsequent questionnaires. This allows interviews conducted at different times for the same respondent (e.g. a pregnant woman who is then followed up post-natally) to be linked reliably, and allows information collected in one interview to be used to control routing and validation in subsequent interviews. For the two projects where we had more than one interaction with the same household, CommCare was the only software which provided in-built linking making it the obvious choice.

Fieldworkers liked the integrated skip patterns as it simplified their interviews, and also reduced the amount of data cleaning required. Fieldworkers also commented on the ability to take photographs and videos as a positive feature in CommCare and ODK Collect. We are utilizing this feature as a data quality check, for example, photographing a child's vaccination record, which we then compared to the recorded data to check the accuracy of data capture.

For CommCare and ODK Collect, there are additional online tools for data which has been submitted electronically. This includes the ability to view the data from any internet access point, create routine reports, and monitor fieldworker's activity. We used this for one CommCare project, allowing the project manager to monitor progress while out of country, a very useful function when principal investigators are not always on site.

Data processing and security

Although all EDC systems can submit data using an Internet connection (Table 2), this method was only used for CommCare in the current projects. Rather than putting SIM cards in fieldworkers' phones, data were submitted when supervisors met interviewers, via local Wi-Fi networks set up on supervisors' laptops using USB dongles connected to a cell phone network. The project manager noted that data could be transferred directly from the phone if fieldworkers were given airtime [phone credit] but this system is more open to abuse, where 'abuse' signifies using project phone credit for personal use. This was a driver in choosing USB downloading in the other EDC systems, an option not fully supported in CommCare. Pendragon fieldworkers reported problems during data download; this was due in part to damage to the PDAs' USB ports from routine field use over 5 years and poor design of the connectors.

Security of data on the devices, often a concern with EDC, was not reported as an issue. Data stored by CommCare and ODK Collect are encrypted and the 'apps', as well as the smartphones can be password protected. Pendragon requires a password to download data. Data stored by MIVA can be encrypted, contains no identifying information, and cannot be interpreted without a translation process.

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Table 2. Summary of the key features, data transfer methods and costs of setting up and running the four electronic data capture systems

Features	Pendragon	CommCare	ODK Collect	MIVA
Integrated GPS	No	Yes	Yes	Yes
Inter-changeable language	No	Yes	Yes	Yes
Internet-free development	Yes	No	Yes	Yes
'Cases'	No	Yes	No	No[a]
Logic				
Complexity of logic	Basic	Intermediate	Intermediate	Advanced
In-built analysis and feedback	Basic	Intermediate[b]	Intermediate[b]	Advanced
Data upload/download				
USB cable	Yes	No	Yes[c]	Yes
Internet	Yes	Yes	Yes	Yes
SMS	No	Yes	No	Yes
Cost				
Start-up costs	Medium	Low	Low	High
Running costs	Low	Medium	Low	Low

ODK: Open Data Kit; MIVA: Mobile InterVA (www.interva.net); Internet-free development: the system can be designed, tested and deployed in the field without needing to connect to the internet, assuming the necessary programmes are already downloaded; Start-up costs: includes purchasing hardware and person-time costs for programming; Running costs: includes phone charging allowances, data download costs and subscription fees.
[a]While the version of MIVA being used does not have this function, it has been added to the latest version.
[b]These EDC systems have simple calculated fields which can be displayed to the user or used in the form's logic, allowing for basic in-built analysis and feedback, however MIVA uses a complex Bayesian model to analyse verbal autopsies into cause of death information.
[c]A programme called ODK Briefcase is used to download and amalgamate the data into.csv files.

However, in one project we experienced SD card malfunctions as a result of purchasing poor quality SD cards locally, causing isolated data loss. We have also had two cases of SD cards being replaced or stolen while they were being charged at a commercial charging service. Of the 64 devices in the field, three devices have been stolen from fieldworkers' houses in rural villages and three from a supervisor's house in the district's main town. Although we subsequently recovered two of these devices, the potential for data loss, the need to replace devices, and the security of fieldworkers needs to be planned for.

Conclusion

Although PDAs and Pendragon were effective and cost-efficient in our case, as we already owned the hardware, this technology is becoming obsolete (although Pendragon has a version which runs on Android and iOS devices), and the software was harder to use than both CommCare and ODK Collect. We would not recommend purchasing PDAs over newer hardware, but if available, they still offer advantages over paper-based systems.

CommCare and ODK Collect have features that may make them appropriate for different contexts. ODK Collect is preferable in areas of poor Internet connectivity as the whole process from form development to data download can be done offline, and is well suited to cross-sectional surveys. CommCare is the appropriate software for studies or programmes requiring multiple encounters with the same respondents such as prospective cohorts, and our experience has shown that poor internet does not necessarily preclude CommCare from being used. In studies with one point of contact with respondents and reasonable internet connectivity, there is little to distinguish between CommCare and ODK Collect.

MIVA was programmed to perform a specific, standardised function, with all the required features built-in, making it very suitable for routine data collection. However, in a research setting we couldn't customise it for our specific needs so we combined it with an ODK application, adding complexity to the interviewer's task. Developing a stand-alone 'app' requires highly skilled people and more time, so we would not recommend this approach for small-scale research projects.

Our experience shows EDC to not only be viable, but desirable for data collection in a rural Sub-Saharan African setting, with each EDC system offering specific advantages and disadvantages. As we have described, the optimal hardware and software combination will be dependent on the nature of the project, budget, and local circumstances.

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Appendix P Antenatal questionnaire

Part A: Personal Details of Mother and Father

First I would like you to tell me about yourself and the father of your baby			
Mother			
1.1	What is your date of birth? How old are you?	Day/Month/Year |__|__|/|__|__|/|__|__| Age (years) |__|__|	
1.2	What is the highest level of school you attended? FOR PRIMARY AND SECONDARY ALSO PUT HIGHEST STANDARD OR FORM REACHED	1 = None |__| 2 = Primary |__| Standard |__| 3 = Secondary |__| Form |__| 4 = Tertiary |__|	
1.3	What is your religion?	1 = Christian catholic |__| 2 = Christian other |__| 3 = Muslim |__| 4 = Aaron |__| 5 = Pagan |__| 6 = Other |__|	
1.4	What is your tribe?	1 = Chewa |__| 2 = Ngoni |__| 3 = Senga |__| 4 = Yao |__| 5 = Tumbuka |__| 6 = Lomwe |__| 7 = Other |__|	
Father			
1.5	What is the age of the man who fathered this pregnancy? IF THE RESPONDENT DOESN'T KNOW THE EXACT AGE, CIRCLE THE CORRECT AGE GROUP	Age (years) |__|__|	
1.6	What is your relationship to him?	1 = Married 2 = Boyfriend/fiancé 3 = Casual acquaintance →	Q1.8
		4 = Relative 5 = Divorced/separated →	Q1.8
		6 = Widowed →	Q1.8
		7 = Other (specify)	
1.7	Which of the following best describes your living arrangements with this man? READ OUT THE LIST OF STATEMENTS	1 = Live together all of the time 2 = Live together but occasionally apart for work reasons 3 = Live together but separated for a period every year for work reasons (i.e. seasonal/ganyu work) 4 = Live apart but regular/frequent cohabitation (i.e. return visits) 5 = Live apart, infrequent cohabitation 6 = Never live together	
1.8	What is the highest level of school he attended? FOR PRIMARY AND SECONDARY ALSO PUT HIGHEST STANDARD OR FORM REACHED	1 = None 2 = Primary |__| Standard |__| 3 = Secondary |__| Form |__| 4 = Tertiary	
1.9	What is his main occupation? PROBE FOR THE ONE WHICH HE SPENDS MOST TIME DOING	1 = Farming 2 = Casual worker/ganyu 3 = Salaried worker 4 = Small business/artisan 5 = Student 6 = No work 7 = Other (specify _____)	

Part B: Details of Pregnancy

I'd like to ask you a few questions now about your current pregnancy.

2.1	What was the date of your last menstrual period? If exact date not known put the first of the month.	Day/ Month/ Year __ __/__ __/__ __	
2.2	How many weeks pregnant are you now? Compare this with the calculated gestation shown in the questionnaire and check health passport.	|__|__| weeks	
2.3	What is your expected delivery date? Compare this with the expected delivery date shown in the questionnaire and check health passport.	Day/ Month/ Year __ __/__ __/__ __	
I would like to ask you some questions that are about your circumstances and feelings around the time you became pregnant. Please think of your current pregnancy when answering these questions. For every question there is a list of possible answers. Please wait and listen to all the responses and then choose the option that is most applicable to you and tell me which one it is. The first question has four possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is. This question asks about contraception. This might include condoms, pills, injections, implants, coils, vasectomy, female sterilisation or any other method aimed at delaying pregnancy.			
2.4	In the month that I became pregnant….	1 = I/we were not using contraception 2 = I/we were using contraception, but not on every occasion 3 = I/we always used contraception, but knew that the method had failed (i.e. broke, moved, came off, came out, not worked etc) at least once 4 = I/we always used contraception	
Now I am going to ask a question and there are three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
2.5	In terms of becoming a mother *(first time or again)*, I feel that my pregnancy happened at the.....	1 = Right time 2 = ok, but not quite right time 3 = wrong time	
The next few questions ask about before you became pregnant. This question also has three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
2.6	Just <u>before</u> I became pregnant…….	1 = I intended to get pregnant 2 = My intentions kept changing 3 = I did not intend to get pregnant	
The next question has three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
2.7	Just <u>before</u> I became pregnant....	1 = I wanted to have a baby 2 = I had mixed feelings about having a baby 3 = I did not want to have a baby	
In the next question, we ask about your partner - this might be (or have been) your husband, a partner you live with, a boyfriend, or someone you've had sex with once or twice. There are three options for the next question. Again thinking about before you became pregnant would you say…			
2.8	<u>Before</u> I became pregnant....	1 = My partner and I had agreed that we would like me to be pregnant 2 = My partner and I had discussed having children together, but hadn't agreed for me to get pregnant 3 = We never discussed having children together	
The last question also asks you to think about before you became pregnant. There is a list of possible options and I would like you to tell me all of those that apply to you.			

2.9	Before you became pregnant, did you do anything to improve your health in preparation for pregnancy?	1 = took iron 2 = saved money 3 = ate more healthily 4 = sought medical/health advice 5 = took some other action, please describe _____ or 6 = I did not do any of the above before my pregnancy	
2.10	Just before I became pregnant....	1 = My partner wanted me to have a baby 2 = My partner I had mixed feelings about me having a baby 3 = My partner did not want me to have a baby	

Part C: Birth History

Now I am going to ask you some questions about all of the pregnancies you have had before this one during your life.			
3.1	Have you ever had a pregnancy that ended before 7 completed months? - A **MISCARRIAGE** IS A PREGNANCY THAT ENDS BEFORE 7 COMPLETED MONTHS	1 = Yes 2 = No →	Q3.3
3.2	How many?	|__|	
3.3	Have you ever had a pregnancy that ended with the baby being born dead? - A **STILLBIRTH** IS A PREGNANCY THAT ENDS AFTER 7 COMPLETED MONTHS, BUT THE BABY IS BORN DEAD i.e. it shows no signs of life after it was born, did not cry, breathe or move an arm or leg.	1 = Yes 2 = No →	Q3.5
3.4	How many?	|__|	
3.5	Have you ever had any children that died at any time after being born? - A **LIVE BIRTH** IS A PREGNANCY THAT ENDS WITH A LIVE BABY, EVEN IF THAT BABY ONLY SURVIVES FOR A FEW MOMENTS	1 = Yes 2 = No →	Q3.8
3.6	How many?	|__|	
3.7	For each child please tell me how old was he / she when he / she died?	1 = 0-7 days 2 = 8-28 days 3 = 29 days -1yr 4 = 1 - 4yrs 5 = >5yrs	
3.8	Do you have any live children of your own?	1 = Yes 2 = No →	Q3.11
3.9	How many?	|__|	
3.10	For each child please tell me how old was he / she on their last birthday?	|__| years |__| years |__| years |__| years |__| years |__| years	
3.11	How long is it since your last birth?	|__| months	

Part D: Depression

Now I am going to ask you some questions about the thoughts and feelings that you have experienced over the last 4 weeks. You should answer yes or no to each question. If you are not sure, give the answer that is closest to how you have been feeling. If you do not understand a question please ask and I can give you an example of what the question means.			
4.1	Do you often have headaches?	1 = Yes 2 = No	
4.2	Is your appetite poor?	1 = Yes 2 = No	
4.3	Do you sleep badly?	1 = Yes 2 = No	
4.4	Do your hands shake?	1 = Yes 2 = No	
4.5	Do you feel nervous tense or worried?	1 = Yes 2 = No	
4.6	Are you easily frightened?	1 = Yes 2 = No	
4.7	Is your digestion poor?	1 = Yes 2 = No	
4.8	Do you have trouble thinking clearly?	1 = Yes 2 = No	
4.9	Do you feel unhappy?	1 = Yes 2 = No	
4.10	Do you cry more than usual?	1 = Yes 2 = No	
4.11	Do you find it difficult to enjoy your daily activities?	1 = Yes 2 = No	
4.12	Do you find it difficult to make decisions?	1 = Yes 2 = No	
4.13	Is your daily work suffering?	1 = Yes 2 = No	
4.14	Are you unable to play a useful part in life?	1 = Yes 2 = No	
4.15	Have you lost interest in things?	1 = Yes 2 = No	
4.16	Do you feel that you are a worthless person?	1 = Yes 2 = No	
4.17	Has the thought of ending your life been on your mind?	1 = Yes 2 = No	
4.18	Do you feel tired all the time?	1 = Yes 2 = No	
4.19	Do you have uncomfortable feelings in your stomach?	1 = Yes 2 = No	
4.20	Are you easily tired?	1 = Yes 2 = No	
Check if the answer is **yes** to Q 4.17 and if so ask the following:			
4.21	Do you have thoughts of suicide all the time?	1 = Yes 2 = No	
4.22	Have you thought of a way that you might commit suicide?	1 = Yes 2 = No	
4.23	Have you tried to kill yourself?	1 = Yes 2 = No	
If the answer to any of these questions is yes, or if the score on the SRQ is >13 please refer her to a health facility			
4.24	Over the year before you became pregnant, did you have times where you felt down, depressed, or hopeless?	1 = Yes 2 = No →	Q4.27
4.25	Did these episodes last for more than two weeks?		
4.26	Over the year before you became pregnant, did you have times where you felt little interest or pleasure in doing things?	1 = Yes 2 = No →	Q5.1
4.27	Did these episodes last for more than two weeks?		

Part E: Household

Look at the house…		Ask the resident…					
5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8
What is the main type of flooring? ☐	What is the main type of roofing? ☐	Do you or members of your HH work on agricultural land? ☐	What is the main HH source of drinking water? ☐	What is the main type of toilet facility used by members of your HH? ☐	Number of members of the HH ☐☐	Number of sleeping rooms ☐	In your HH is there… (Y/N)
1 = Dirt, sand or dung 2 = Wood or plank 3 = Cement 4 = Tiles 5 = Other	1 = Natural material (e.g. grass) 2 = Iron sheets 3 = Iron and tiles 4 = Asbestos 5 = Cement 6 = Other	1 = Mainly on own or family's land 2 = Mainly on rented or someone else's land 3 = Do not do agricultural work	1 = Piped water inside house 2 = Piped water into yard or plot 3 = Public tap (piped) 4 = Protected well/borehole 5 = Traditional public well 6 = River, canal or surface water	1 = Own flush toilet 2 = Shared flush toilet 3 = Traditional pit toilet 4 = VIP pit latrine 5 = Bush or field 6 = Other	(including those sleeping in boys + girls hostels)	(including boys + girls hostels)	Electricity? ___ A radio? ___ A bicycle? ___ A motorcycle? ___ A car? ___ A paraffin lamp? ___ An oxcart? ___ A domestic worker not related to the head of the HH? ___

Thank you, this is the end of the questions. Now I would like to take some measurements from you:

6.1	Mother's height (in centimetres)	|__|__|__|.|__|
6.2	Mother's MUAC (in millimetres)	|__|__|__|

We will return about a month after you deliver.

Check that the woman is happy and answer any questions that she may have at this point.

Appendix Q Postnatal questionnaire

Part A: Details About the Recent Pregnancy

First I would like to ask you about the details of your recent pregnancy			
I would like to ask you some questions that are about your circumstances and feelings around the time you became pregnant. Please think of your current pregnancy when answering these questions. For every question there is a list of possible answers. Please wait and listen to all the responses and then choose the option that is most applicable to you and tell me which one it is. The first question has four possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is. This question asks about contraception. This might include condoms, pills, injections, implants, coils, vasectomy, female sterilisation or any other method aimed at delaying pregnancy.			
1.1	In the month that I became pregnant….	1 = I/we were not using contraception 2 = I/we were using contraception, but not on every occasion 3 = I/we always used contraception, but knew that the method had failed (i.e. broke, moved, came off, came out, not worked etc) at least once 4 = I/we always used contraception	
Now I am going to ask a question and there are three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
1.2	In terms of becoming a mother *(first time or again)*, I feel that my pregnancy happened at the.....	1 = Right time 2 = ok, but not quite right time 3 = wrong time	
The next few questions ask about before you became pregnant. This question also has three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
1.3	Just before I became pregnant….....	1 = I intended to get pregnant 2 = My intentions kept changing 3 = I did not intend to get pregnant	
The next question has three possible responses to it. Please choose the one option that is most applicable to you and tell me which one it is.			
1.4	Just before I became pregnant....	1 = I wanted to have a baby 2 = I had mixed feelings about having a baby 3 = I did not want to have a baby	
In the next question, we ask about your partner - this might be (or have been) your husband, a partner you live with, a boyfriend, or someone you've had sex with once or twice. There are three options for the next question. Again thinking about before you became pregnant would you say…			
1.5	Before I became pregnant....	1 = My partner and I had agreed that we would like me to be pregnant 2 = My partner and I had discussed having children together, but hadn't agreed for me to get pregnant 3 = We never discussed having children together	
The last question also asks you to think about before you became pregnant. There is a list of possible options and I would like you to tell me all of those that apply to you.			
1.6	Before you became pregnant, did you do anything to improve your health in preparation for pregnancy?	1 = took iron 2 = saved money 3 = ate more healthily 4 = sought medical/health advice 5 = took some other action, please describe _____ or 6 = I did not do any of the above before my pregnancy	
1.7	Just before I became pregnant....	1 = My partner wanted me to have a baby 2 = My partner I had mixed feelings about me having a baby 3 = My partner did not want me to have a baby	
ANC			

1.8	Did you go for an antenatal check-up during this pregnancy?	1 = Yes 2 = No →	Q1.15
1.9	Where did you go? PROBE FOR MORE CIRCLE ALL THAT APPLY FOR OUTREACH SPECIFY WHERE THE OUTREACH WAS, NOT THE HEALTH FACILITY THAT IT CAME FROM	1 = Mchinji District Hospital 2 = Kapiri 3 = Kaigwazanga 4 = Kochilira 5 = Mkanda 6 = Guillime 7 = Nkhwazi 8 = Chipumi 9 = Chiwosha 10 = Ludzi 11 = Mikundi 12 = Kapanga 13 = Tembwe 14 = St Gabriel's 15 = TBA 16 = Outreach (specify _____) 17 = Other (specify _____)	
1.10	How many months pregnant were you when you first went?	|__| months	
1.11	How many times did you go altogether during this pregnancy?	|__|__| times	
1.12	Did you have a Tetanus Toxoid Vaccine (TTV) injection in the arm during this pregnancy?	1 = Yes 2 = No	
1.13	During any of your antenatal visits did the provider give information on contraception?	1 = Yes → 2 = No	Q1.16
1.14	If no, would you have liked some?	1 = Yes 2 = No	
1.15	Why did you not go to ANC?		
1.16	Did you go to anyone else for advice during your pregnancy?	1 = Yes 2 = No →	Q1.18
1.17	Who did you go to?	1 = TBA 2 = Sing'anga 3 = Grandmother 4 = Other (specify _____)	
1.18	During this pregnancy how often did you take iron tablets or syrup?	1 = Every day 2 = Some days 3 = Never	
1.19	During this pregnancy, did you take any drugs in order to prevent you from getting malaria? NOT CONSIDERED HERE ARE INSTANCES WHEN YOU TOOK THE DRUG BECAUSE YOU HAD MALARIA	1 = Yes 2 = No	
1.20	Does your household have any mosquito nets that can be used while sleeping?	1 = Yes 2 = No →	Q1.26
1.21	How many mosquito nets does your household have?	|__|	
1.22	Since you got the mosquito net, was it ever soaked or dipped in chemicals to repel mosquitoes or insects?	1 = Yes 2 = No → 3 = Not sure →	Q1.24 Q1.24
1.23	When was the last time the net was soaked or dipped in these chemicals?	|__|__| months ago	
1.24	Did anyone sleep under a mosquito net last night? CIRCLE ALL THAT APPLY	1 = Nobody 2 = Self 3 = Husband 4 = New baby 5 = All other children	

		6 = Some other children 7 = Other (specify _____)	
1.25	During this pregnancy, how often did you sleep under the mosquito net?	1 = Every night 2 = Some nights 3 = Never	
1.26	I do not want to know the result, but have you ever been for VCT?	1 = Yes 2 = No	

Part B: Problems, Healthcare-seeking and Treatment – Mother

Antenatal problems				
2.1 Were you sick or did you have any serious problems during the recent pregnancy?			1 = Yes 2 = No → Q3.1	
Now I would like to ask you about ALL the problems you had while you were pregnant this time				
2.2 What was the first/next problem you had? PROBE FOR MORE PROBLEMS	2.3 Did you consult anybody?	2.4 If YES, who were the people you consulted? SELECT ALL THAT APPLY	2.5 Did you have to ask permission from anyone before you could go there? If YES, who?	2.6 How long was it from the start of your illness until the problem was resolved.
1	|__|	|__|	|__|	|__|__| days |__|__| hours
2	|__|	|__|	|__|	|__|__| days |__|__| hours
3	|__|	|__|	|__|	|__|__| days |__|__| hours
4	|__|	|__|	|__|	|__|__| days |__|__| hours
	1 = Yes → 2.5 2 = No → 2.2 (SKIP TO NEXT PROBLEM)	1 = Sing'anga 2 = TBA 3 = HSA 4 = Health worker in Mchinji 5 = Health worker outside Mchinji 6 = Grandmother 7 = Mother 8 = Mother-in-law 9 = Other relative 10 = Other (specify)	1 = No 2 = Husband 3 = Mother 4 = Father 5 = Mother-in-law 6 = Other relative 7 = Other (specify)	Go to 2.2

Delivery			
3.1	Did this pregnacy end in a miscarriage?	1 = Yes → 2 = No	Q5.7

The next questions are about the delivery			
3.2	Where did you go to deliver?	1 = Mchinji District Hospital 2 = Kapiri 3 = Kaigwazanga 4 = Kochilira 5 = Mkanda 6 = Guillime 7 = Nkhwazi 8 = Chipumi 9 = Chiwosha 10 = Ludzi 11 = Mikundi 12 = Kapanga 13 = Tembwe 14 = St Gabriel's 15 = TBA 16 = At home 17 = On the way to health facility 18 = Other (specify _____)	
3.3	How long did the labour last?	1 = 0 – 6 hours 2 = 7 – 12 hours 3 = 13 – 18 hours 4 = 19 – 24 hours 5 = >24 hours	
3.4	Did you drink 'mwana mphepo' medicine to assist labour?	1 = Yes 2 = No →	Q3.6
3.5	How many spoonfuls did you drink?	|__| spoonfuls	
3.6	Who helped with the delivery? CIRCLE ALL MENTIONED	1 = Doctor/Nurse/Clinical Officer/Midwife 2 = Other health worker 3 = TBA 4 = Relative/friend 5 = Nobody →	Q3.9
3.7	Did the person who helped wash his/her hands with soap before the delivery?	1 = Yes 2 = No 3 = Don't know	
3.8	Did the person who helped wear gloves during the delivery?	1 = Yes 2 = No 3 = Don't know	
3.9	How many babies were delivered?	|__|	
3.10	How many babies were delivered alive?	|__|	3.9=3.10 →3.12
3.11	How many babies were delivered stillborn?	|__|	
Only if they delivered in a health facility:			
3.12	After the delivery did the provider give information on contraception?	1 = Yes → 2 = No	Q4.1
3.13	If no, would you have liked some?	1 = Yes 2 = No	

Delivery Problems	
4.1 Were you sick or did you have any serious problems during this delivery?	1 = Yes 2 = No-- (→ Q5.1)

Now I would like to ask you about ALL the problems you had during this delivery				
4.2 What was the first/ next problem you had? PROBE FOR MORE PROBLEMS	4.3 Did you consult anybody?	4.4 If YES, who were the people you consulted? SELECT ALL THAT APPLY	4.5 Did you have to ask permission from anyone before you could go there? If YES, who?	4.6 How long was it from the start of your illness until the problem was resolved?
1	|__|	|__|	|__|	|__|__| days |__|__| hours
2	|__|	|__|	|__|	|__|__| days |__|__| hours
3	|__|	|__|	|__|	|__|__| days |__|__| hours
	1 = Yes → 4.5 2 = No → 4.2 (SKIP TO NEXT PROBLEM)	1 = Sing'anga 2 = TBA 3 = HSA 4 = Health worker in Mchinji 5 = Health worker outside Mchinji 6 = Grandmother 7 = Mother 8 = Mother-in-law 9 = Other relative 10 = Other (specify)	1 = No 2 = Husband 3 = Mother 4 = Father 5 = Mother-in-law 6 = Other relative 7 = Other (specify)	Go to 4.2

Post-natal Problems				
5.1 Were you sick or did you have any serious problems after this delivery?			1 = Yes 2 = No ---------- (→ Q5.7)	
5.2 What was the first/next problem you had? PROBE FOR MORE PROBLEMS	5.3 Did you consult anybody?	5.4 If YES, who were the people you consulted? SELECT ALL THAT APPLY	5.5 Did you have to ask permission from anyone before you could go there? If YES, who?	5.6 How long was it from the start of your illness until the problem was resolved?
1	|__|	|__|	|__|	|__|__| days |__|__| hours
2	|__|	|__|	|__|	|__|__| days |__|__| hours
3	|__|	|__|	|__|	|__|__| days |__|__| hours
	1 = Yes →5.5 2 = No → 5.2 (SKIP TO NEXT PROBLEM)	1 = Sing'anga 2 = TBA 3 = HSA 4 = Health worker in Mchinji 5 = Health worker outside Mchinji 6 = Grandmother 7 = Mother 8 = Mother-in-law 9 = Other relative 10 = Other (specify)	1 = No 2 = Husband 3 = Mother 4 = Father 5 = Mother-in-law 6 = Other relative 7 = Other (specify)	Go to 5.2

The next questions ask about your thoughts and feelings since you gave birth. Please answer yes or no to the following questions.			
5.7	Do you often have headaches?	1 = Yes 2 = No	
5.8	Is your appetite poor?	1 = Yes 2 = No	
5.9	Do you sleep badly?	1 = Yes 2 = No	
5.10	Do your hands shake?	1 = Yes 2 = No	
5.11	Do you feel nervous tense or worried?	1 = Yes 2 = No	
5.12	Are you easily frightened?	1 = Yes 2 = No	
5.13	Is your digestion poor?	1 = Yes 2 = No	
5.14	Do you have trouble thinking clearly?	1 = Yes 2 = No	
5.15	Do you feel unhappy?	1 = Yes 2 = No	
5.16	Do you cry more than usual?	1 = Yes 2 = No	
5.17	Do you find it difficult to enjoy your daily activities?	1 = Yes 2 = No	
5.18	Do you find it difficult to make decisions?	1 = Yes 2 = No	
5.19	Is your daily work suffering?	1 = Yes 2 = No	
5.20	Are you unable to play a useful part in life?	1 = Yes 2 = No	
5.21	Have you lost interest in things?	1 = Yes 2 = No	
5.22	Do you feel that you are a worthless person?	1 = Yes 2 = No	
5.23	Has the thought of ending your life been on your mind?	1 = Yes 2 = No	
5.24	Do you feel tired all the time?	1 = Yes 2 = No	
5.25	Do you have uncomfortable feelings in your stomach?	1 = Yes 2 = No	
5.26	Are you easily tired?	1 = Yes 2 = No	
Check if the answer is yes to Q 5.23 and if so ask the following:			
5.27	Do you have thoughts of suicide all the time?	1 = Yes 2 = No	
5.28	Have you thought of a way that you might commit suicide?	1 = Yes 2 = No	
5.29	Have you tried to kill yourself?	1 = Yes 2 = No	
If the answer to any of these questions is yes, or if the score on the SRQ is >13 please refer her to a health facility			
5.30	Antenatally this woman was given information to seek help for her symptoms. Did she attend?	1 = Yes → 2 = No	Q6.1
5.31	Why not?		

Part C: Family Planning and Relationships

Now I would like to ask you some questions about family planning and sexual relationships in your family. I know that many people feel shy talking about these sorts of things, but I would like to assure you that everything you tell me will be kept in confidence.			
Family Planning			
6.1	Have you ever used family planning in the past? If yes, which methods? DO NOT READ THE LIST CIRCLE ALL METHODS MENTIONED PROBE FOR MORE ANSWERS	1 = Lactational amenorrhea 2 = Pill 3 = Norplant 4 = Depo (Injection) 5 = Condom 6 = Loop 7 = Chingwe 8 = Traditional medicine 9 = Following cycles 10 = Withdrawal 11 = Abstinence 12 = Others (specify_____) 13 = No	Q6.3 “ “ “ “ “ “ “ “ “ “ “ Q6.2
6.2	If no, why not?	1 = Family planning services not available / accessible 2 = Concerns about side effects of methods 3 = Costs too much 4 = Not aware of family planning or where to get it 5 = Wanted to get pregnant 6 = Not having sex / infrequent sex 7 = Opposed to use 8 = Partner opposed to use 9 = Other (specify_____) 10 = Don’t know	
6.3	At the time you became pregnant, did you want to become pregnant then, did you want to wait until later, or did you not want to have any (more) children at all?	1 = Then→ 2 = Later 3 = Not at all →	Q6.5 Q6.5
6.4	How much longer would you have liked to wait?	Years |__|__|	
6.5	Have you resumed sexual relations since the birth of your baby?	1 = Yes → 2 = No	Q6.7
6.6	How many months after the birth do you expect to resume sex?	|__| months →	Q6.9
6.7	Are you currently doing something or using any method to delay or avoid getting pregnant? If yes, which method?	1 = Lactational amenorrhea 2 = Pill 3 = Norplant 4 = Depo (Injection) 5 = Condom 6 = Loop 7 = Chingwe 8 = Traditional medicine 9 = Following cycles 10 = Withdrawal 11 = Abstinence 12 = Others (specify_____) 13 = No	Q6.9 “ “ “ “ “ “ “ “ “ “ “ Q6.8
6.8	If not, why not?	1 = Family planning services not available / accessible 2 = Concerns about side effects of methods 3 = Costs too much 4 = Not aware of family planning or where to get it	

		5 = Breastfeeding / amenorrhea 6 = Not / infrequent sex 7 = Opposed to use 8 = Partner opposed to use 9 = Other (specify_____) 10 = Don't know	
6.9	Thinking about the future, would you like to have another child, or would you prefer not to have any more children?	1 = More 2 = No more →	Q6.12
6.10	How many more children would you like to have?	|__| children	
6.11	How long would you like to wait from now before the birth of another child?	|__|__| years	
6.12	If you could chose exactly the number of living children to have in your whole life, how many would that be?	|__|__| children	
	Relationships		
6.13	What is your marital status now?	1 = Married 2 = Single/never married → 3 = Divorced/separated → 4 = Widowed → 5 = Other (specify)	 Q6.17 Q6.17 Q6.17
6.14	How long have you been in this relationship?	|__|__| years	
6.15	Does this man have any wives apart from you? If yes, how many?	1 = Yes |__| wives 2 = No →	 Q6.17
6.16	Are you the first, second, third… wife?	|__|__| rank	
Violence is a problem for many women and can affect their health and wellbeing. Again I would like to assure you that everything you tell me will be kept in confidence.			
6.17	Have you ever been emotionally or physically abused by your partner or someone important to you?	1 = Yes 2 = No	
6.18	In the last year have you been hit, slapped, kicked, punched or otherwise physically hurt by someone?	1 = Yes 2 = No →	Q6.21
6.19	Who was this?		
6.20	How many times?	|__|__| times	
6.21	While you were pregnant were you hit, slapped, kicked, punched or otherwise physically hurt by someone?	1 = Yes 2 = No →	Q6.24
6.22	Who was this?		
6.23	How many times?	|__|__| times	
6.24	Within the last year has someone made you so something sexual that you did not want to do?	1 = Yes 2 = No →	Q6.27
6.25	Who was this?		
6.26	How many times?	|__|__| times	
If the answer is 'yes' to any of 6.17, 6.18, 6.19 or 6.24 then ask 6.27			
6.27	Are you afraid of your partner or anyone else you have listed above?	1 = Yes 2 = No	
Check if the answer to any of these questions was yes and give her information on where she can seek help.			
6.28	Do you have someone who you can share your worries or concerns with?	1 = Yes 2 = No →	Q6.30
6.29	Who is this?	1 = Husband 2 = Mother 3 = Father 4 = Mother-in-law 5 = Other relative 6 = Friend 7 = Other (specify)	
6.30	How much control do you feel you have in making important decisions that affect your and your children's health?	1 = No control 2 = Control over very few decisions 3 = Control over some decisions 4 = Control over most decisions 5 = Control over all decisions	

Part D: Exposure to Interventions

Now I would like to ask you some questions about community activities that you are involved with in your village			
7.1	Have you ever attended a MaiMwana women's group meeting?	1 = Yes 2 = No →	Q7.3
7.2	How many times did you go?	|__|__| times →	
7.3	Have you ever been counselled by a MaiMwana infant feeding counsellor?	1 = Yes 2 = No →	Q8.1
7.4	How many times were you visited by her in the last 6 months?	|__| times	

Part E: The Newborn Baby
COMPLETE A SEPARATE FORM FOR EACH BABY IF THEY ARE TWINS/MULTIPLE

Now I would like you to tell me about the birth of your baby. What is your baby's name?			
Details of the birth			
8.1	Is your baby a girl or a boy?	1 = Girl 2 = Boy	
8.2	What date was (NAME) born on?	Day/ Month/ Year __ __/__ __/__ __	
8.3	Was (NAME) born early, late, or at the expected time?	1 = Early 2 = On time 3 = Late	
8.4	After how many completed months of pregnancy was (NAME) born?	|__|__| months	
8.5	How was the baby delivered?	1 = Normal 2 = Breech 3 = Forceps/vacuum 4 = C-section	
8.6	Was (NAME) the first or second born twin?	1 = First 2 = Second 3 = Third	
8.7	How big was the baby?	1 = Bigger than average 2 = Average 3 = Smaller than average	
8.8	Was (NAME) weighed at birth?	1 = Yes 2 = No →	Q8.10
8.9	How much did (NAME) weigh? CHECK HEALTH PASSPORT	|__|.|__| kilogrammes	
8.10	Has (NAME) had a BCG immunisation? CHECK HEALTH PASSPORT	1 = Yes 2 = No	
8.11	Has (NAME) had oral polio vaccine? CHECK HEALTH PASSPORT	1 = Yes 2 = No	
8.12	Is (NAME) still alive?	1 = Yes 2 = No →	Q8.14
8.13	Enter baby's unique ID number (Mother's ID number then 01 / 02 / 03)	|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|	Q9.1
8.14	When did (NAME) die?	1 = 0-7 days 2 = 8-28 days 3 = After 28 days	
Post-natal Check-up			
9.1	After the baby was born, did a health professional or a traditional birth attendant check on your or your baby's health? THIS DOES NOT INCLUDE CHECKS MADE BY HEALTH WORKERS IMMEDIATELY AFTER A DELIVERY AT A HEALTH FACILITY	1 = Yes 2 = No →	Q9.7
9.2	How many days after delivery did the first check take place?	|__|__| days	

9.3	Why did you go?	1 = Normal check-up 2 = Problem for mother 3 = Problem for baby	
9.4	Where did this first check take place? FOR OUTREACH SPECIFY WHERE THE OUTREACH WAS, NOT THE HEALTH FACILITY THAT IT CAME FROM	1 = Mchinji District Hospital 2 = Kapiri 3 = Kaigwazanga 4 = Kochilira 5 = Mkanda 6 = Guillime 7 = Nkhwazi 8 = Chipumi 9 = Chiwosha 10 = Ludzi 11 = Mikundi 12 = Kapanga 13 = Tembwe 14 = St Gabriel's 15 = TBA 16 = Outreach (specify _____) 17 = Other (specify _____)	
9.5	Did the provider give information on contraception?	1 = Yes → 2 = No	Q9.8
9.6	If no, would you have liked some?	1 = Yes 2 = No	
9.7	Why was there not a check?		
Now I would like you to tell me about how you fed your baby			
Breastfeeding			
9.8	Have you ever breastfed (NAME)?	1 = Yes→ 2 = No →	Q9.10 Q9.9
9.9	Why not?	1 = Problem for mother 2 = Problem for baby 3 = Other (specify _____)	Q10.1
9.10	How long after birth did you first breastfeed the baby/put (NAME) to the breast?	|__|__| hours |__|__| minutes	
9.11	Are you still breastfeeding (NAME)?	1 = Yes → 2 = No	Q9.13
9.12	Why did you stop breastfeeding?	1 = Problem for mother 2 = Problem for baby 3 = Other (specify _____)	
9.13	Has (NAME) had any food or drink other than breastmilk since he/she was born? INCLUDE WATER, WATER-BASED DRINKS AND ALL FOOD BUT NOT LIQUID MEDICINES AND LIQUID VITAMINS OR MINERALS	1 = Yes 2 = No	

Part F: Problems, Healthcare-seeking and Treatment – Baby

10.1 Has your baby been sick or had any serious problems since being born?	1 = Yes 2 = No ---------- (→ Q10.7)

Now I would like to ask you about all the problems your baby has had since being born.

10.2 What was the first/next problem (NAME) had? PROBE FOR MORE PROBLEMS	10.3 Did you consult anybody?	10.4 If YES, who were the people you consulted? SELECT ALL THAT APPLY	10.5 Did you have to ask permission from anyone before you could go there? If YES, who?	10.6 How long was it from the start of the illness until the problem was resolved?
1	|__|	|__|	|__|	|__|__| days |__|__| hours
2	|__|	|__|	|__|	|__|__| days |__|__| hours
3	|__|	|__|	|__|	|__|__| days |__|__| hours
4	|__|	|__|	|__|	|__|__| days |__|__| hours
	1 = Yes →10.4 2 = No → 10.2 (SKIP TO NEXT PROBLEM)	1 = Sing'anga 2 = TBA 3 = HSA 4 = Health worker in Mchinji 5 = Health worker outside Mchinji 6 = Grandmother 7 = Other relative 8 = Other (specify)	1 = No 2 = Husband 3 = Mother 4 = Father 5 = Mother-in-law 6 = Other relative 7 = Other (specify)	

10.7	Has the baby had a cough?	1 = Yes 2 = No →	10.9
10.8	How many days did the cough last?	|__|__| days	
10.9	Has the baby had any fast breathing for more than 6 hours?	1 = Yes 2 = No	
10.10	Has the baby had difficulty in feeding?	1 = Yes 2 = No	
10.11	Has the baby had diarrhoea more than 3 times a day?	1 = Yes 2 = No	
10.12	Has the baby had a high fever?	1 = Yes 2 = No →	10.14
10.13	How many days did the fever last?	|__|__| days	
10.14	Has the baby had any infection of the umbilical cord? PROBE ABOUT REDNESS OF DISCHARGE AROUND THE STUMP	1 = Yes 2 = No	
10.15	Has the baby had jaundice?	1 = Yes 2 = No	

Thank you very much, that is the end of the questions.

Now I would like to take some measurements of your baby

Baby one		
11.1	Baby weight	|__|.|__| kilogrammes
11.2	Baby length	|__|__|.|__| centimetres
Baby two		
11.3	Baby weight	|__|.|__| kilogrammes
11.4	Baby length	|__|__|.|__| centimetres
Baby three		
11.5	Baby weight	|__|.|__| kilogrammes
11.6	Baby length	|__|__|.|__| centimetres

Appendix R Information sheets and consent forms

MaiMwana Project

University of Malawi
KAMUZU COLLEGE OF NURSING

UCL Institute of Child Health

INFORMATION SHEET: STUDY TO VALIDATE THE LONDON MEASURE OF UNPLANNED PREGNANCY IN THE CHICHEWA LANGUAGE IN THE MCHINJI DISTRICT OF MALAWI

We would like to invite you to participate in this research project. You do not have to take part in this research if you don't want to.

This is a research study conducted by **Dr Jennifer Hall and Professor Judith Stephenson** from **University College London** in England. This work is being carried out in collaboration with **Dr Address Malata** Principal of the Kamuzu College of Nursing at the **University of Malawi** and **Dr Geraldine Barrett** of **Brunel University, London.**
The London Measure of Unplanned Pregnancy (LMUP) is a six item questionnaire that aims to **assess how planned or unplanned a woman's current, or most recent, pregnancy is**. The LMUP was originally developed in the United Kingdom by Dr Barrett but has since been used in other countries including India, the United States of America and Brazil. We are interested in **testing the LMUP in Malawi** to check that it works as well here as it does elsewhere.

The measurement and understanding of pregnancy intention is essential to understand things such as the need for family planning in the region and how decisions are made about when to have children. It is also necessary if we are to understand whether the degree of pregnancy intention has any impact on maternal and child health and if so how. There are still high numbers of maternal and child deaths in Malawi and **understanding the influence of pregnancy intention on this could suggest ways in which these deaths could be prevented**. If the LMUP is found to be suitable for use in Mchinji we plan to use it in a larger study in 2013 that will be looking in to these relationships.

In order to test the LMUP in Mchinji we have translated it into Chichewa. Now we need to check the translation and we would like to ask you to help us with this. We will be asking a small number of pregnant women to talk to us about the questions that we are asking in the LMUP. We need to be sure that women can understand the questions so that they are answering the questions that we think that we are asking. If our translation is not good enough it might mean that people misunderstand the questions and we aren't able to get the information that we are looking for. It is important to be aware that we are not testing you but the translated LMUP; we will not be judging your answers as right or wrong.

If you agree to participate in this research **we would like to ask you to participate in a one to one interview** where we will ask you a series of questions about you and your understanding of the questions in our Chichewa version of the LMUP. The interview will be conducted by Dr Hall with the aid of a translator. If you agree to be interviewed it will take **about 45 minutes** of your time. We would like to **record the interview** so that we can make a careful analysis of the discussions. These recordings will be written up and kept securely. Your responses will be used to improve the Chichewa LMUP.

Agreeing to take part in this research

Your participation is entirely voluntary. If you don't want to take part, you can refuse without any penalty or loss of benefits to you. It is important to be aware that **the antenatal care that you receive here will not be affected in any way whether or not you decide to take part**. If you do agree to participate and then change your mind, please tell the researchers and they will end your participation immediately, without question and without any penalty or loss of benefits to you. You can do this at any point during this study.

Benefits of taking part in this research

Although there are no direct benefits to yourself of taking part in this research, your participation will be an important contribution to work that will help us to understand more about pregnancy intention in Mchinji. The hope is that this information can ultimately be used to reduce maternal and child deaths in Mchinji. As we will not have your contact information we will not be able to provide you with a copy of the results automatically. However if you would like to see these please contact Dr Hall who will ensure that you are provided with a copy.

Potential harms involved in taking part in this research

We do not anticipate that any harm will come to you through your participation in this research. However it is possible that feelings of regret or distress might be provoked by some of the questions about your pregnancy. If this occurs and you do not wish to continue, please inform the researcher who will stop the interview immediately. If you would like to talk to someone about the feelings generated by these questions please contact Dr Hall.

If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

Confidentiality

As a participant in the research you can expect that all the information you provide will be treated in confidence. The responses that you provide will only be used by the researchers. We will not be asking for your name and no one outside the research team will know how you answered the questions. We will not tell anyone at the College of Nursing or Ministry of Health about your responses.

Ethical approval

The ethics committee of the Institute of Child Health at University College London and the College of Medicine Research Ethics Committee (COMREC) have approved this study (application numbers 3974/001 and P.03/12/1273).

More information

For further questions about this research, your rights as a subject, or any adverse effects related to the research, please contact the MaiMwana Project office:

Dr Jennifer Hall, Centre for International Health and Development, Institute of Child Health, University College London. Email: Jennifer.hall@ucl.ac.uk Telephone: 0997707124

Please discuss the information above with others if you wish or ask us if there is anything that is not clear or if you would like more information.

Remember, it is up to you to decide whether to take part or not; choosing not to take part will not disadvantage you in any way. If you do decide to take part you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the United Kingdom's Data Protection Act 1998 and the MaiMwana Data Policy.

MaiMwana Project

University of Malawi
KAMUZU COLLEGE OF NURSING

UCL Institute of Child Health

INFORMED CONSENT FORM: STUDY TO VALIDATE THE LONDON MEASURE OF UNPLANNED PREGNANCY IN THE CHICHEWA LANGUAGE IN THE MCHINJI DISTRICT OF MALAWI

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you. **Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.**
If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement
I _____
(NAME)

- have read the notes written above and the Information Sheet, and understand what the study involves.
- understand that this interview will be recorded. I understand that the tapes will be transcribed and kept for some time before being destroyed.
- agree that the researchers may transfer the information that I provide to the Institute of Child Health at University College London and use it in their analysis.
- understand that the information I give will be treated in the strictest confidence by the researchers in accordance with the provisions of the Data Protection Act 1998.
- understand that at any time I may withdraw from this study without giving a reason and that I will not be affected negatively in any way if I do not want to participate or if I decide to withdraw.
- agree that the research project named above has been explained to me to my satisfaction and I voluntarily agree to take part in this study.

Please tick as appropriate:

☐ I agree that my comments in interview may be quoted and that these quotations may be attributed to me

☐ I agree that my comments in the interview may be quoted, but I would like my name to be anonymised

☐ I do not agree that any of my comments in the interview may be quoted, even anonymously, but the researchers may use information from my interview to inform their analysis

Participant's signature: _____ Date: _____

Researcher's name (please print): _____ **Date: _____**

Researcher's signature: _____

This study has been approved by the UCL Research Ethics Committee and the University of Malawi's College of Medicine Research Ethics Committee **(**application numbers 3974/001 and P.03/12/1273)

MaiMwana Project

University of Malawi
KAMUZU COLLEGE OF NURSING

UCL Institute of Child Health

INFORMATION SHEET: STUDY TO INVESTIGATE THE RELATIONSHIPS BETWEEN PREGNANCY INTENTION AND MATERNAL AND NEONATAL HEALTH IN THE MCHINJI DISTRICT OF MALAWI

We would like to invite you to participate in this research project. You do not have to take part in this research if you do not want to.

This is a research study conducted by **Dr Jennifer Hall and Professor Judith Stephenson** from **University College London** in England. This work is being carried out in collaboration with **Dr Address Malata** Principal of the Kamuzu College of Nursing at the **University of Malawi and MaiMwana.** In an ideal world men and women would be able to choose how many children they would like and when they would like them. In reality this is not always the case and we know that **worldwide every year there are millions of pregnancies that 'unplanned'**. An 'unplanned' or 'unintended' pregnancy is a pregnancy that has happened two or more years earlier than desired or that is not wanted at all. **We think that how planned or unplanned a pregnancy is might have implications for the health of both the woman and her baby**. The aim of this study is to explore these relationships.

If you agree to participate in this research **we would like to ask you some questions today**. These will be about you, your partner, use of family planning and any pregnancies that you may have had in the past. We estimate that this will take about half an hour. **We would also like to come back about one month after you have had your baby** to ask you some more questions about your pregnancy, the birth, your baby and any health problems that you or your baby have had. At this time we would also like to weigh and measure the length your baby. Altogether this will take about one hour.

We will be collecting this information from about 4000 women across Mchinji district. The information will be used to understand whether the degree of pregnancy intention has any impact on maternal and child health and if so how. There are high numbers of maternal and child deaths in Malawi and **understanding the influence of pregnancy intention on this could suggest ways in which these deaths could be prevented**. Understanding pregnancy intention is also helpful to understand things such as the need for family planning in the region and how decisions are made about when to have children.

Agreeing to take part in this research

Your participation is entirely voluntary. If you don't want to take part, you can refuse without any penalty or loss of benefits to you. It is important to be aware that **any care that you or your baby receive while you are taking part in this research will not be affected in any way whether or not you decide to take part**. If you do agree to participate and then change your mind later, please tell the researchers and they will end your participation immediately, without question and without any penalty or loss of benefits to you. You can do this at any point during this study and we can remove your data from the study if you wish. Equally if there are any questions that you don't want to answer you don't have to. There are no right or wrong answers to these questions; we just want to know about your experiences.

Benefits of taking part in this research

Although there are no direct benefits to yourself of taking part in this research, your participation will be an important contribution to work that will help us to understand more about pregnancy intention in Malawi and how this relates to the health of women and their babies. The hope is that this information can ultimately be used to reduce maternal and child deaths in Malawi. At the end of the research we will arrange events in your local area where you can come and find out about the results. If you would like a summary of the results in Chichewa please contact Dr Hall who will ensure that you are provided with a copy.

Potential harms involved in taking part in this research

We do not anticipate that any harm will come to you through your participation in this research. However it is possible that feelings of regret or distress might be provoked by some of the questions about your current or previous pregnancies. If this occurs and you do not wish to continue, please inform the researcher who will stop the interview immediately. If you would like to talk to someone about the feelings generated by these questions please contact Dr Hall.

If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

Confidentiality

As a participant in the research you can expect that all the information you provide will be treated in confidence. The responses that you provide to questions will only be used by the researchers. No one outside the research team will know how you answered the questions. We will not tell anyone at the College of Nursing or Ministry of Health about your responses.

Ethical approval

The ethics committee of the Institute of Child Health at University College London and the College of Medicine Research Ethics Committee (COMREC) have approved this study (application numbers 3974/001 and P.03/12/1273).

More information

For further questions about this research, your rights as a subject, or any adverse effects related to the research, please contact:

Dr Jennifer Hall, Centre for International Health and Development, Institute of Child Health, University College London. Email: Jennifer.hall@ucl.ac.uk Telephone: 0997707124

Please discuss the information above with others if you wish or ask us if there is anything that is not clear or if you would like more information.

Remember, it is up to you to decide whether to take part or not; choosing not to take part will not disadvantage you in any way. If you do decide to take part you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the United Kingdom's Data Protection Act 1998.

MaiMwana Project

University of Malawi
KAMUZU COLLEGE OF NURSING

UCL Institute of Child Health

INFORMED CONSENT FORM FOR STUDY TO INVESTIGATE THE RELATIONSHIPS BETWEEN PREGNANCY INTENTION AND MATERNAL AND IN THE MCHINJI DISTRICT OF MALAWI

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you. **Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.**
If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement

I _____ **(NAME)**

- have read the notes written above and the Information Sheet, and understand what the study involves.
- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately and that neither I nor the care of myself or my baby will be affected negatively in any way if I do not want to participate.
- understand that my responses will be used to explore the relationships between pregnancy intention and the health of mothers and their new babies in Mchinji district and I agree that the researchers may transfer the information that I provide to the Institute of Child Health at University College London and use it in their analysis.
- understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the UK's Data Protection Act 1998.
- agree that the research project named above has been explained to me to my satisfaction and I voluntarily agree to take part in this study.

Participant's signature: _____ **Date:** _____

Researcher's name (please print): _____**Date:** _____

Researcher's signature: _____

This study has been approved by the UCL Research Ethics Committee and the University of Malawi's College of Medicine Research Ethics Committee **(**application numbers 3974/001 and P.03/12/1273)

STUDY TO EXPLORE THE ATTITUDES TO AND EXPERIENCES OF USING POST-PARTUM FAMILY PLANNING SERVICES IN THE MCHINJI DISTRICT OF MALAWI

We would like to invite you to participate in this research project. If you don't want to take part in this research you don't have to.

This is a research study conducted by **Dr Jennifer Hall and Professor Judith Stephenson** from **University College London** in England. This work is being carried out in collaboration with **Dr Address Malata** Principal of the Kamuzu College of Nursing at the **University of Malawi.**

In an ideal world men and women would be able to choose how many children they would like and when they would like them. In reality this is not always the case and we know that **worldwide every year there are millions of pregnancies that 'unplanned'**. An 'unplanned' or 'unintended' pregnancy is a pregnancy that has happened two or more years earlier than desired or that is not wanted at all. One of the ways to reduce the number of unplanned pregnancies is through the provision of family planning services.

If you agree to participate in this research **we would like to ask you to participate in a group discussion about family planning.** In this group discussion we are hoping to hear more about any experiences you have of using, or trying to use methods of family planning, and your thoughts on the local family planning services, particularly in relation to using family planning after the birth of a baby. The group that you would be joining is [all female / all male]

If you take part in one of these discussion groups, it will take **between one and two hours** of your time. There will be one researcher leading the discussion and one researcher taking notes. Please note that **the group discussions will be recorded** so we can make a careful analysis of the discussions. These recordings will be written up and kept securely.

There are high numbers of maternal and child deaths in Malawi and improving access to and use of post-partum family planning **could be one of the ways in which these deaths could be prevented**. Understanding communities' attitudes to and experiences of family planning is helpful to understand things such as the need for family planning in the region and to improve the services that are provided.

Agreeing to take part in this research

Your participation is entirely voluntary. If you don't want to take part, you can refuse without any penalty or loss of benefits to you. If you do agree to participate and then change your mind later, please tell the researchers and they will end your participation immediately, without question and without any penalty or loss of benefits to you. You can do this at any point during this study.

Benefits of taking part in this research

Although there are no direct benefits to yourself of taking part in this research, your participation will be an important contribution to work that will help us to understand

the attitudes to post-partum family planning in Mchinji and what problems there are with the current post-partum family planning services. The hope is that this information can be used to improve the accessibility and acceptability of post-partum family planning services in Mchinji. This could contribute to reducing the numbers of unplanned pregnancy and may help to reduce maternal and child deaths in Mchinji. At the end of the research we will arrange events in your local area where you can come and find out about the results. If you would like a summary of the results in Chichewa please contact Dr Hall who will ensure that you are provided with a copy.

Potential harms involved in taking part in this research

We do not anticipate that any harm will come to you through your participation in this research. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

Confidentiality

As a participant in the research you can expect that all the information you provide will be treated in confidence. We will be analysing the group discussion and may like to include some anonymous quotes in our report.

For the group discussions we cannot guarantee absolute confidentiality as other participants may tell others outside the group what was said. Nevertheless, we will reinforce the importance of respecting the confidentiality of the group to all participants before we start the discussion.

Compensation

So that you are not out of pocket as a result of your participation in the group discussion your travel costs will be reimbursed. You will also be provided with light refreshments after the group discussion.

Ethical approval

The ethics committee of the Institute of Child Health at University College London and the College of Medicine Research Ethics Committee (COMREC) (application numbers 3974/001 and P.03/12/1273).

More information

For further questions about this research, your rights as a subject, or any adverse effects related to the research, please contact MaiMwana project or: **Dr Jennifer Hall**, **UCL Institute for Global Health, Email: Jennifer.hall@ucl.ac.uk, Telephone: 0997707124**

Please discuss the information above with others if you wish or ask us if there is anything that is not clear or if you would like more information.

Remember, it is up to you to decide whether to take part or not; choosing not to take part will not disadvantage you in any way. If you do decide to take part you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the United Kingdom's Data Protection Act 1998.

STUDY TO EXPLORE THE ATTITUDES TO AND EXPERIENCES OF USING POST-PARTUM FAMILY PLANNING SERVICES IN THE MCHINJI DISTRICT OF MALAWI

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you. **Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.**

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in.

Participant's Statement I _____ **(NAME)**

- have read the notes written above and the Information Sheet, and understand what the study involves.
- understand that these discussions will be recorded. I understand that the tapes will be transcribed and kept for some time before being destroyed.
- agree that the researchers may transfer the information that I provide to the Institute of Child Health at University College London and use it in their analysis.
- understand that the information I give will be treated in the strictest confidence by the researchers in accordance with the provisions of the Data Protection Act 1998. However, if I participate in a focus group, I understand that the researchers cannot guarantee the anonymity and confidentiality of these discussions although all participants will be reminded of the importance of respecting the confidentiality of the group before we start the discussion.
- understand that at any time I may withdraw from this study without giving a reason and that I will not be affected negatively in any way if I do not want to participate or if I decide to withdraw.
- agree that the research project named above has been explained to me to my satisfaction and I voluntarily agree to take part in this
- agree that my comments in the group discussion may be quoted anonymously

Participant's signature: _____ **Date:** _____

Researcher's name (please print): _____**Date:** _____

Researcher's signature: _____

This study has been approved by the UCL Research Ethics Committee and the University of Malawi's College of Medicine Research Ethics Committee **(**application numbers 3974/001 and P.03/12/1273)

Appendix S Timetable of maternal mental health issues training

Day One	Timings
Introduction: • Admin- complete baseline questionnaires • Opening prayer • Introductions and Icebreaker • Expectations for the day: 3 things for the day • Ground rules • Plan for the day, timings, breaks, exits	9-10 ALL of us together
Session 1: • Perinatal Mental Health Project DVD • Exercise: 3 things for you noticed	10-11 Khwima/Selena
BREAK: 10-10.30	
Session2: Woman's transition to motherhood What is maternal mental health? Vulnerability and resilience Why maternal mental health matters	11-11.45 Khwima
Outline of maternal mental health problems	11.45-12.30 Selena
LUNCH 12:30- 13:30	
Starting your assessment: Essential Communication skills	13:00-14:30 Tilinao - good and bad communication skills: show DVD clips.
BREAK	14:30-15:00
Stress management & relaxation Techniques	15:00 – 16:00 Khwima
Recap of day's learning points	16:00-16:30 ALL

DAY TWO	
Recap of Day One, revisit of ground rules etc.	08:00-08:30 ALL
Mental health disorders across the perinatal period: case scenarios thoughts, feelings and behaviours	09:00-10:00 Selena and Khwima
BREAK	10:00-10:30
Taking a mental health history DVD, then small group role play	10:30-12:00 Selena/Khwima
LUNCH	12:00- 13:00
Assessing severity/ risk Mental Health Case Studies	13:00- 14:30 Khwima/Tilinao
BREAK	14:30-15:00
Counselling skills: part 2 Problem solving strategies	15:00 – 16:00 Tilinao
Recap of day's learning points & relaxation exercise	16:00-16:30 ALL - Khwima

DAY THREE	
Recap	08:00-08:30
Management of mental health difficulties	08.30- 10.00 Selena and Khwima
Break	10.00-10.30
Refresh of history taking skills (small group) & counselling skills: part 3 FINAL QUESTIONNAIRES	10.30-12.00 ALL – small groups 12.00-12.30

Appendix T Types of missing data

After data collection consideration was given to the amount of missing data as well as to the type to determine how to handle it. This means assessing whether the data was missing completely at random (MCAR), missing at random (MAR) or missing not at random (MNAR) as described by Rubin (402). This is important as the type of missing data influences how representative the remaining data are. If missing data are MCAR then it means that the reason that they are missing is not related to any observed or unobserved factor and occurs entirely at random. In this instance the data would still be representative of the underlying population and the missing data will not introduce new bias into the results, however this type of missing data is the least common.

If missing data are MAR then the reason that the data is missing can be explained by differences in other variables in the data and is unrelated to the unobserved value itself. In this case it is possible to explain the missing values in terms of other recorded measurements. For example, in my data babies born at home may be less likely to have a birthweight recorded than those born at a health facility.

Data that are MNAR are missing for a reason that is related to the value of the missing data. For example, a person may choose not to answer a question about their lifetime number of sexual partners because they did not want to reveal what they felt was a low or high number of partners. This type of missing data potentially introduces the largest sources of bias.

In reality it is often not possible to determine the reason why the data are missing. Although there is no cut off point to reference, a small amount of missing data (often taken to be less than 5% but dependent on the size of the dataset) is generally considered unlikely to make an important difference to the conclusions regardless of how the missing data are handled.

Appendix U Multiple imputation model for missing birthweight data

Based on the determinants of low birthweight identified in section 3.3.2.7 of the literature review, I developed the list of variables to be considered for inclusion in the multiple imputation of the missing birthweight data. The complete list is shown in Table 13-1.

It was not possible, or necessary, to collect data on all of the possible determinants identified in the literature. Some, such as tobacco and alcohol use, were not considered relevant in this setting (shaded in red in Table 13-1). Others, such as paternal anthropometry, pre-pregnancy weight and gestational weight gain, were not possible given the design of the study (shaded in grey in Table 13-1). For some of these factors I was able to collect proxy data. Maternal mid-upper arm circumference (MUAC) was collected as a marker of maternal nutrition, in lieu of pre-pregnancy weight and weight gain. Taking the iron / folic acid supplement was used as a contributor to maternal diet. Finally, formal diagnoses of malaria were not recorded, but use of intermittent preventative treatment during pregnancy was included in the model, as were antenatal problems, which included women reporting episodes of malaria.

Delivery factors are not determinants of birthweight, however where the baby was delivered and who delivered it were important determinants of whether or not the baby was weighed at birth in these data. Since they help to explain why data were missing they were included in the model. Multiple imputation models should include not only the variables of relevance to the imputation but also the outcomes and other factors included in the final multivariate analyses models. LMUP score, previous depression, number of live children and geographical cluster were therefore also included in this model.

The postnatal infant factors are clearly not determinants of birthweight, but were collected to help to impute these data. The measurement of the baby's weight and length at these postnatal visits, and the age of the baby at the time of the visit, was used to calculate z-scores for height-for-age, weight-for age and weight-for-height which were included in the model. Whether or not the baby was alive at the time of the postnatal visit was also included, as low birthweight babies may have had a higher risk of neonatal mortality.

Factors considered for inclusion in the multiple imputation model for missing birth weight data						
Socio-demographic / economic	**Parental anthropometry**	**Obstetric history**	**Antenatal factors**	**Delivery factors**	**Infant factors**	**Infant postnatal factors**
Socio-economic status	Maternal height	Parity	ANC uptake^	Location	Sex	Weight at postnatal visit
Maternal age	Pre-pregnancy weight	Birth interval	Morbidity+	Person	Maternal estimate of size	Length at postnatal visit
Maternal education	Paternal height	History of LBW baby	Malaria		Multiple birth	Age at postnatal visit
Paternal education	Paternal weight	Number of live children	Gestational weight gain		Maternal estimate of gestation	Alive at postnatal visit
Marital status	Maternal birth weight		Caloric intake			
Intimate partner violence	Maternal MUAC		Iron/folic acid use			
Safe water*			IPTp			
Rural area**			Smoking			
Ethnicity			Alcohol			
Previous depression			LMUP			
Measured and included	**Relevant to main analysis**	**Data not collected**	**Proxy for data not collected**	**Not applicable**	**Postnatal factors used in imputation model**	
* included in measure of SES			^ measured by months at booking and total attendances			
** cluster variable included, also captured in measure of SES			+ reported antenatal problems (any, including malaria) and antenatal SRQ score			

Table 13-1 Factors considered for inclusion in the multiple imputation model for missing birthweight data.

Appendix V Principal components analysis to develop asset index

Methods

The variables collected and considered to construct the measure of socio-economic status (SES) are shown in Table 13-2. As there is no guide on what it is good practice to include (333, 403) these were selected on the basis of previous work in the area (404) and local knowledge of SES, and are similar to those used in the Malawi DHS (22).

Variable	Options	Variable	Options
Roof composition	0 Natural	Work the land	0 Work on rented land
	1 Iron sheets		1 Work on own land
	2 Iron and tiles		2 Don't work on the land
	3 Cement	Electricity	0 no
Floor composition	0 Dirt		1 yes
	1 Wood	Phone	0 no
	2 Cement		1 yes
	3 Tiles	Paraffin lamp	0 no
Water source	0 River		1 yes
	1 Traditional well	Oxcart	0 no
	2 Protected well		1 yes
	3 Public piped tap	Bicycle	0 no
	4 Piped water in yard		1 yes
	5 Piped water inside	Motorcycle	0 no
Type of toilet facility	0 Bush		1 yes
	1 Traditional pit latrine	Car	0 no
	2 VIP pit latrine		1 yes
	3 Shared flush toilet	Domestic worker	0 no
	4 Own flush toilet		1 yes
Number of people in the house	Numeric	Radio	0 no
Number of rooms in the house	Numeric		1 yes

Table 13-2 Variables considered for PCA to construct a measure of SES

During data cleaning I ordered the coding as shown in Table 13-2 so that for all variables zero was assigned to the response considered to represent the poorest household or the absence of an asset (332). For variables with more than 2 response categories, I combined those categories with very low levels of response (fewer than 20 respondents) with their nearest equivalent (328). For example, only 3 women out of 4244 reported having wooden floors so I combined these with those reporting dirt floors. For binary variables there was no requirement set for a minimum proportion to have the asset for the variable to be included, although any variable where no one owned the asset would be of no use and would therefore be discarded; this was not the case in these data.

I created a variable for household density by dividing the number of people in the house by the number of rooms. This was then grouped into quintiles. The 'work the land' variable was used to create a binary variable where working on the land was coded zero and not working on the land was coded one. An additional binary variable was created from the asset list of 'none' where households with no assets scored zero and households with at least one asset scored one and an asset count variable was created by summing the total number of assets reported.

To check whether these variables were likely to be good indicators of SES, each variable was correlated with the education level of the father and

mother of the child respectively as a reasonable proxy for household SES. These correlations were examined to check whether all the variables moved in the expected direction e.g. ownership of an asset or access to improved sanitation was more likely with higher education, to test their value for use in the principal components analysis (PCA).

The correlation coefficients of all the variables were calculated in a correlation matrix to check the strength and direction of the association between the variables. Where two variables had a correlation coefficient of >0.8 this would suggest that they are measuring the same dimension of poverty are therefore interchangeable. In this case one would be discarded to avoid collinearity.

I calculated the scale reliability coefficient using the Cronbach's alpha with 0.6 considered to be acceptable, prior to testing the PCA model for its explanatory power and skewness. Individual variables that had not performed well on the univariate correlation with education or in the correlation coefficient matrix were removed and the Cronbach's alpha and PCA repeated. Once the final set of variables for the PCA was determined I used the model to calculate the SES score for each household. This variable was then divided into quintiles. I did a sensitivity analysis to compare a PCA model with all the variables included verses those that were ultimately selected.

Results

For most variables the correlations showed the expected relationship with education. For example higher levels of education were associated with higher levels of mobile phone ownership. There were several deviations from the expected relationships. For example, ownership of an oxcart or a paraffin lamp was inversely associated with paternal education, suggesting that ownership of these items was actually associated with poverty rather than vice versa. Motorbike ownership was rare, but had a non-linear relationship with education.

These variables were therefore tested further in the development of the final PCA model. In addition the binary variable for working on the land had a stronger association with education level than the categorical variable and was retained in preference to the categorical variable.

There were no correlation coefficients >0.8 indicating that no variable was redundant. Most variables were positively correlated with each other but in keeping with the observations above ownership of a lamp, motorbike or oxcart had some negative correlations with other variables but these were small and not consistent enough to warrant automatic exclusion.

The scale reliability coefficient calculated using Cronbach's alpha for the whole scale was 0.6142 which is borderline low but acceptable. Removing motorbike or oxcart marginally lowered the scale reliability coefficient (0.6136 and 0.6119 respectively), removing all three improved the scale reliability

coefficient slightly to 0.6158 but just removing the ‘lamp’ variable increased this further to 0.6179.

Iterative analysis of PCA models including and excluding the variables lamp, motorbike and oxcart determined that the preferred model was one including all variables except lamp. This model had an Eigenvalue of 3.33 for component 1 which explained 20.8% of the variation in SES.

Appendix W Choice of antenatal regression model

As explained in section 5.4.3.1, the choice of regression method for the factors associated with pregnancy intention as measured by the London Measure of Unplanned Pregnancy (LMUP) is not immediately apparent. To determine the best model to use for the multivariate regression I explored and compared five different approaches; one linear, two logistic and two ordinal logistic models.

The linear model has the advantages of relative simplicity, use of the whole of the range of LMUP scores from zero to twelve and ease of interpretation. However, using a linear model assumes that the relationship we are looking at is linear and that each interval on the scale is equivalent, which may not be the case for the LMUP, i.e. the difference between pregnancies that score three and four may or may not be the same as the difference between pregnancies that score ten and eleven. In addition, for the model to be valid the residuals should be normally distributed and independent and the variance of the residuals should be constant. Treating the ordinal score as linear may violate the assumption that the variance of the LMUP score is homogenous across the variables of interest and while the parameter estimate may be unbiased, the estimates of variance may be biased and inconsistent (405). In exploring the linear model these assumptions will be formally tested.

Logistic models are used for binary outcomes which means first converting the LMUP score from an ordinal to a binary outcome. Until recently this was the most common approach in situations where the outcome is ordinal categorical but there are two main limitations to this. Firstly, it results in a loss of information as categories are collapsed – and in the case of the LMUP collapsing 13 categories to two would result in the loss of a lot of information – and a therefore a loss of power to investigate relationships. Secondly, the choice of cut-off is not obvious and can influence the results (406). Simulations have shown that the optimal cut-point in terms of efficiency is considered to be where the cut creates two groups with equal numbers, i.e. at the median, and that this model is asymptotically 75% efficient as compared to an ordinal regression of a five-point scale (it will be less efficient for a 13 point scale like the LMUP). However, this is an arbitrary cut-point making the results difficult to interpret and of little practical use. An alternative would be to choose a cut-point that is hypothesised to be relevant on the basis of theory, for example for the LMUP a cut-point at nine, above which pregnancies would be described as ‘planned’. Both cut-points will be tested and compared, with the latter referred to as ‘Log want’ and the former as ‘Log med’. Introducing a cut-point in this way is arbitrary, and the high starting number of categories exacerbates the arbitrariness for the LMUP, suggesting that ordinal regression might be preferable (406)

Ordinal logistic regression is a newer technique that has increasingly been used since the early 1990s when these commands became available in common statistical packages. It was developed in recognition of the aforementioned limitations of collapsing ordinal scores to binary outcomes and of the growing amount of health data that was being collected on ordinal

scales e.g. of pain or quality of life (405). There are two main types of ordinal regression: the proportional odds model and the continuation ratio model. The proportional odds model is the model most commonly used, is available as standard in Stata and is the model recommended for use in the multivariate analysis of the LMUP when it is used as the dependent variable.

The theory behind the proportional odds model (also called the cumulative odds model) is an extension of the logistic model for binary data and is based on the assumption that there is an underlying continuous variable from which the ordered categorical variable is created (406). The proportional odds model calculates cut-point specific odds ratios at each cut-point, using all observations in the data every time but at a different level of dichotomisation. So a five-point ordinal scale would have four cut-points: comparing the first category to the last four categories; the first two categories to the last three categories; the first three categories to the last two categories; and finally the first four categories to the last category. From this, one summary odds ratio is calculated, based on the maximisation likelihood function, which is valid over all cut-points simultaneously (405). This means that inferences can be made across the range of the outcome considered, whereas the results of the binary logistic regression are confined to one cut-point. This model is based on the assumption of homogeneity of odds ratios across each cut-point, an assumption that will be tested.

There is no guidance on how many cut-points can be managed by an ordinal logistic regression. The LMUP guidance analysis recommends using the full scale of the LMUP wherever possible (8). While it is possible that the software would not be able to handle it, with a dataset of this size and with no rare scores on the LMUP, there is no *a priori* reason not to attempt to use the whole scale. The full LMUP score range of zero to 12 will therefore be used in the ordinal logistic model (referred to as 'LMUP all') but will be compared with the cut-points suggested from the UK data and supported by the Mchinji data, where zero to three is classed as 'unplanned', four to nine as 'ambivalent' and ten and above as 'planned' (referred to as 'LMUP 3'). Whilst these cut points seem theoretically valid, reducing the LMUP from a 13-point scale to a three point scale in some way negates the value of having collected it in the first place and potentially results in the loss of a large amount of information.

Univariate analyses

The relationship of each variable with LMUP score was considered using each type of regression analysis. The summary of these results, including crude coefficients and odds ratios, is presented in Table 13-3. For most variables there were no differences between the types of regression or with the univariate analysis with regards to which were statistically significantly associated with pregnancy intention, though there were some small variations in the size, but not direction, of the estimated effects. The exception was cluster where there was variation across the models as to what which clusters were statistically significant. In general the ordinal logistic models had the most precision (narrowest confidence intervals) but the differences between the models were small and non-significant.

Variable		Type of regression model				
		Linear	Log med	Log want	LMUP all	LMUP 3
		Coefficient (95%CI)	Odds ratio (95% confidence interval)			
Mother's age	18-29	Baseline				
	15-17	-1.03 (-1.46, -0.59)	0.63 (0.50, 0.78)	0.79 (0.64, 0.99)	0.66 (0.54, 0.80)	0.61 (0.50, 0.76)
	>=30	-1.31(-1.59, -1.03)	0.54 (0.47, 0.62)	0.52 (0.45, 0.61)	0.57 (0.50, 0.64)	0.56 (0.49, 0.64)
Father's age	20-29	Baseline				
	15-19	-2.02(-2.69, -1.35)	0.38 (0.27, 0.55)	0.46 (0.32, 0.66)	0.43 (0.32, 0.58)	0.38 (0.27, 0.53)
	>=30	-0.98 (-1.23, -0.73)	0.62 (0.54, 0.70)	0.58 (0.51, 0.66)	0.65 (0.58, 0.72)	0.64 (0.57, 0.71)
Mother's education level (years)		0.15 (0.11, 0.18)	1.07 (1.04, 1.09)	1.06 (1.04, 1.09)	1.07 (1.05, 1.09)	1.06 (1.04, 1.08)
Father's education level (years)		0.07 (0.03, 0.10)	1.02 (1.01, 1.05)	1.03 (1.01, 1.05)	1.03 (1.02, 1.05)	1.03 (1.01, 1.04)
Marital status	married	Baseline				
	unmarried	-3.40 (-3.89, -2.97)	0.16 (0.12, 0.21)	0.19 (0.14, 0.26)	0.24 (0.20, 0.29)	0.18 (0.15, 0.23)
Number of live children		-0.53 (-0.60, -0.47)	0.77 (0.74, 0.80)	0.74 (0.72, 0.77)	0.79 (0.76, 0.81)	0.78 (0.75, 0.80)
Primagravida	yes	1.43 (1.17, 1.69)	1.92 (1.68, 2.20)	2.59 (2.26, 2.97)	2.02 (1.79, 2.27)	2.16 (1.90, 2.46)
	no	Baseline				
Intergestational period	<2yrs	Baseline				
	2-3yrs	1.44 (1.10, 1.79)	1.99 (1.66, 2.40)	1.73 (1.43, 2.10)	1.86 (1.59, 2.18)	1.90 (1.60, 2.24)
	3-4yrs	2.04 (1.64, 2.44)	2.94 (2.37, 3.65)	2.27 (1.82, 2.82)	2.39 (1.99, 2.88)	2.36 (1.94, 2.87)
	4-5yrs	2.70 (2.19, 3.22)	3.89 (2.93, 5.17)	2.64 (2.00, 3.48)	3.11 (2.46, 3.92)	3.11 (2.43, 4.00)
	>5yrs	2.55 (2.04, 3.06)	3.71 (2.81, 4.90)	2.84 (2.16, 3.72)	2.92 (2.31, 3.68)	3.10 (2.41, 3.99)
Socio-economic status	- poorest 20%	Baseline				
	- second poorest 20%	0.35 (-0.03, 0.74)	1.16 (0.96, 1.41)	1.10 (0.90, 1.33)	1.15 (0.97, 1.36)	1.16 (0.97, 1.38)
	- middle 20%	0.47 (0.09, 0.86)	1.24 (1.02, 1.50)	1.11 (0.91, 1.35)	1.20 (1.02, 1.42)	1.25 (1.04, 1.49)
	- next richest 20%	0.74 (0.35, 1.12)	1.39 (1.15, 1.69)	1.31 (1.08, 1.59)	1.40 (1.18, 1.65)	1.37 (1.14, 1.64)
	- richest 20%	0.83 (0.45, 1.21)	1.38 (1.14, 1.67)	1.30 (1.07, 1.57)	1.52 (1.28, 1.81)	1.39 (1.16, 1.66)

Variable	Type of regression model				
	Linear	Log med	Log want	LMUP all	LMUP 3
	Coefficient (95%CI)	Odds ratio (95% confidence interval)			
Previous depression - none	Baseline				
- one/two for less than 2 weeks	-0.95 (-1.28, -0.61)	0.58 (0.49, 0.69)	0.61 (0.51, 0.72)	0.69 (0.60, 0.81)	0.64 (0.55, 0.75)
- one for more than 2 weeks	-1.93 (-2.29, -1.57)	0.36 (0.30, 0.44)	0.41 (0.33, 0.50)	0.45 (0.38, 0.53)	0.44 (0.37, 0.52)
- both for more than 2 weeks	-2.23 (-3.30, -1.16)	0.30 (0.16, 0.54)	0.37 (0.20, 0.68)	0.38 (0.24, 0.62)	0.45 (0.27, 0.73)
Distance to health facility (kms)	No statistically significant differences in any model				
Gestation (months)	-0.10 (-0.18 -0.022)	0.95 (0.91, 0.99)	0.93 (0.90,0.97)	0.96 (0.93, 1.0)	0.95 (0.91, 0.98)
Religion	No statistically significant differences in any model				
Tribe	In all models Senga tribe was the only one statistically significantly different to baseline (Chewa)				
Cluster	Not presented due to the number of clusters (n=25) but findings consistent across the models				
Zone 1	Baseline				
Zone 2	-0.21 (-0.50, 0.087)	0.95 (0.82, 1.10)	0.74 (0.64, 0.86)	0.78 (0.69, 0.89)	0.92 (0.81, 1.06)
Zone 3	-0.42 (-0.71, -0.13)	0.84 (0.72, 0.97)	0.96 (0.83, 1.10)	0.79 (0.70, 0.91)	0.91 (0.80. 1.05)

Table 13-3 Findings from the univariate analyses for the five different regression models

Multivariate regression

Multivariate models using each type of regression and including all variables were initially created and used to determine which was the most appropriate regression. The results of the five multivariate regressions (linear, logistic at median and 'wanted' cut-points and ordinal logistic of the whole 13 point LMUP scale and of the three categorisations) are shown in Table 13-4. Those shown in bold were significant at $p<0.05$. In this table each variable is described as the 'same' or 'different' across the models. If the variable is consistently significant, or consistently not significant, across all the models then it is described as 'same', otherwise as 'different'. This fairly crude distinction is for illustrative purposes in the comparison of the different models; often the differences are qualitatively very small as will be discussed further.

Random effects of cluster

The variable 'cluster' reflects the geographical area from which the woman was recruited. This was included in the model as a possible random effect so in Stata the data were 'st set' with cluster as the panel variable. In the linear model rho (the fraction of variance due to differences between the clusters) was zero indicating that cluster did not have a significant effect once other factors in the model were taken into account. Although rho was small in all of the logistic regressions, the hypothesis that rho=0 was rejected, suggesting that in these models cluster did have some effect.

	Linear			Log med			Log want			LMUP all			LMUP 3			Comparison of models
	β coef.	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		
Mother's age	18-29 as baseline															
- 15-17	**-1.10**	**-1.56**	**-0.63**	**0.54**	**0.40**	**0.74**	**0.54**	**0.39**	**0.74**	**0.60**	**0.47**	**0.76**	0.50	0.37	0.66	Same
- >=30	0.39	0.00	0.78	**1.32**	**1.02**	**1.71**	**1.36**	**1.05**	**1.76**	**1.25**	**1.02**	**1.52**	1.24	0.99	1.54	Different
Father's age	20-29 as baseline															
- 15-19	**-1.44**	**-2.10**	**-0.78**	**0.45**	**0.29**	**0.69**	**0.43**	**0.28**	**0.69**	**0.47**	**0.34**	**0.65**	**0.40**	**0.27**	**0.59**	Same
- >=30	**0.48**	**0.16**	**0.81**	1.22	0.98	1.51	**1.33**	**1.07**	**1.65**	**1.26**	**1.07**	**1.49**	**1.29**	**1.07**	**1.55**	Different
Mother's education level (yrs)	-0.01	-0.05	0.03	0.98	0.95	1.01	**0.96**	**0.94**	**0.99**	1.00	0.97	1.02	0.98	0.96	1.01	Different
Father's education level (yrs)	-0.03	-0.06	0.01	0.98	0.96	1.00	0.98	0.96	1.01	0.99	0.97	1.01	0.98	0.96	1.00	Same
Unmarried	**-3.71**	**-4.16**	**-3.25**	**0.10**	**0.07**	**0.15**	**0.10**	**0.07**	**0.15**	**0.15**	**0.12**	**0.20**	**0.11**	**0.08**	**0.14**	Same
Number of live children	**-0.76**	**-0.87**	**-0.64**	**0.61**	**0.57**	**0.66**	**0.62**	**0.57**	**0.68**	**0.70**	**0.66**	**0.74**	**0.68**	**0.64**	**0.73**	Same
Birth interval	First birth as baseline															
- Within 24 months	**-2.07**	**-2.45**	**-1.68**	**0.35**	**0.27**	**0.45**	**0.26**	**0.20**	**0.34**	**0.37**	**0.30**	**0.45**	**0.28**	**0.22**	**0.35**	Same
- 2-3 years	**-0.74**	**-1.14**	**-0.34**	0.79	0.60	1.04	**0.49**	**0.38**	**0.65**	**0.66**	**0.54**	**0.81**	**0.52**	**0.41**	**0.66**	Different
- More than 3 years	0.33	-0.08	0.74	**1.72**	**1.29**	**2.30**	0.87	0.66	1.15	1.05	0.86	1.29	0.88	0.68	1.12	Different
Gestation (months)	-0.06	-0.13	0.01	0.97	0.92	1.02	0.97	0.92	1.02	0.99	0.95	1.02	0.97	0.93	1.01	Same
Socio-economic status	Poorest 20% as baseline															
- second poorest 20%	-0.13	-0.49	0.22	0.86	0.68	1.08	0.82	0.65	1.04	0.90	0.75	1.07	0.89	0.72	1.09	Same
- middle 20%	-0.13	-0.49	0.22	0.87	0.69	1.10	0.82	0.64	1.04	0.88	0.74	1.05	0.92	0.75	1.14	
- next richest 20%	0.31	-0.04	0.67	1.07	0.84	1.36	1.03	0.81	1.31	1.05	0.88	1.26	1.09	0.89	1.34	
- richest 20%	0.33	-0.05	0.71	1.01	0.78	1.31	0.97	0.74	1.25	1.02	0.84	1.24	1.02	0.81	1.27	

	Linear			Log med			Log want			LMUP all			LMUP 3			Comparison of models
	β coef.	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		
Previous depression	None as the baseline															
- 1 or 2, < 2 weeks	**-0.85**	**-1.17**	**-0.54**	**0.55**	**0.44**	**0.67**	**0.52**	**0.42**	**0.64**	**0.62**	**0.53**	**0.73**	**0.59**	**0.49**	**0.71**	Same
- One, ≥ 2 weeks	**-1.34**	**-1.68**	**-1.00**	**0.38**	**0.30**	**0.48**	**0.42**	**0.33**	**0.54**	**0.52**	**0.43**	**0.62**	**0.49**	**0.40**	**0.60**	
- Both, ≥ 2 weeks	**-1.65**	**-2.69**	**-0.61**	**0.34**	**0.17**	**0.68**	**0.36**	**0.17**	**0.74**	**0.38**	**0.22**	**0.65**	**0.52**	**0.29**	**0.92**	
Distance to health facility	<2.5km as the baseline															
- 2.5 - 4.99km	0.15	-0.24	0.54	**1.38**	**1.03**	**1.86**	**1.42**	**1.05**	**1.92**	1.22	0.97	1.53	1.23	0.95	1.60	Different
- 5 - 7.49km	0.22	-0.15	0.59	**1.37**	**1.02**	**1.86**	**1.54**	**1.14**	**2.10**	1.17	0.93	1.48	1.26	0.97	1.64	Different
- more than 7.5km	0.18	-0.20	0.56	1.26	0.91	1.74	1.38	1.00	1.93	1.11	0.86	1.42	1.16	0.87	1.53	Same
Religion	Non-Catholic Christian as the baseline															
- Catholic	-0.11	-0.35	0.12	0.96	0.81	1.13	1.11	0.94	1.31	1.00	0.88	1.14	0.97	0.84	1.12	Same
- Muslim	-0.05	-1.11	1.01	0.77	0.38	1.54	0.58	0.29	1.17	0.75	0.43	1.30	0.66	0.36	1.23	
- Other	0.09	-0.81	0.99	1.02	0.53	1.93	0.79	0.41	1.49	0.92	0.59	1.45	0.89	0.53	1.51	
Tribe	Chewa as the baseline															
- Ngoni	**-0.56**	**-1.01**	**-0.11**	**0.70**	**0.51**	**0.95**	**0.72**	**0.53**	**0.99**	0.86	0.68	1.09	**0.73**	**0.56**	**0.96**	Different
- Senga	**1.16**	**0.64**	**1.68**	0.97	0.57	1.64	1.01	0.60	1.71	1.07	0.72	1.60	1.05	0.66	1.68	
- Yao	0.17	-0.89	1.23	1.17	0.58	2.33	1.19	0.60	2.38	1.17	0.68	2.01	1.26	0.69	2.31	Same
- Other	0.10	-0.80	1.00	1.12	0.61	2.07	0.94	0.52	1.69	0.91	0.57	1.45	0.94	0.56	1.59	
rho	rho=0 not rejected			0.08	0.04	0.14	0.15	0.09	0.25	rho=0 rejected at p<0.05						Different

Table 13-4 Comparison of five multivariate regression models

Assessment of the linear regression

Most regressions found mother's age over 30 to be associated with pregnancies that are more unplanned but on linear regression the p-value for mother's age over 30 was p=0.05. This is of borderline significance but was not highlighted as significant in the table for consistency.

The standardised residuals are non-Normally distributed (Figure 13-1) and the variance of residuals is not constant across the values fitted by the model (Figure 13-2) meaning that the assumptions have been violated for the linear regression model. However, with a large sample size, such as this, it is possible to relax these assumptions slightly (p115) (334), and to help accommodate the non-Normal distribution of the residuals and the heteroskedasticity of the variance, robust (or Huber–White) standard errors can be calculated (p354) (334). The calculation of these standard errors makes no assumptions as the underlying probability model but instead estimates them from the variability in the data. This method tends to result in larger standard errors and wider confidence intervals. The result of these violations is that, while the model is probably suitable to assess the existence of associations, there may be some slight errors in the estimations of the coefficients and their standard errors.

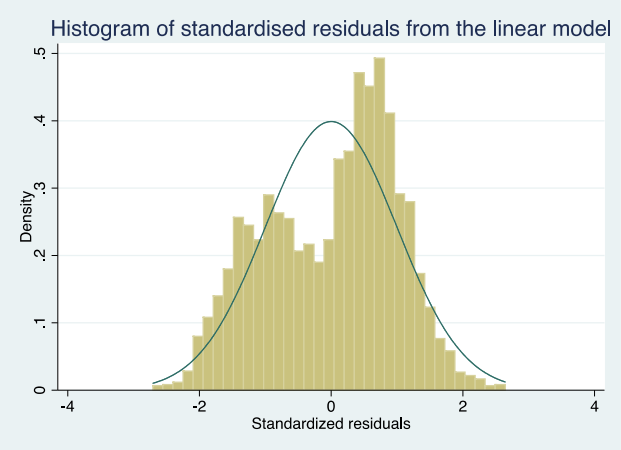

Figure 13-1 Histogram of the standardised residuals from the linear regression

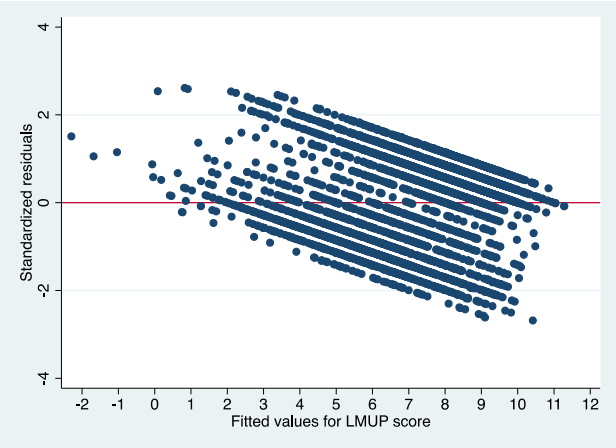

Figure 13-2 Scatter plot of standardised residuals against fitted values to show the variance of the residuals from the linear regression

The linear regression model predicted values with a range from -2.30 to 11.3 (see Figure 13-2). The negative values, which are not possible on the LMUP, could be because the linear regression model does not quite fit the data or because these women have extreme values for some variables. The outliers with a score below zero were explored in more detail.

Five women were predicted an LMUP score of less than zero. Starting from the constant of 9.81 as the LMUP score, all five women were unmarried (-3.72 points), had a birth interval of 24 months or less (-2.07 points) and four of the five had six or more live children (-0.754 points per child, -3.02 to -6.03 total). Having this many children as an unmarried woman was uncommon; the majority of unmarried women (66%) were having their first child. Unmarried women were also generally more likely to have had longer inter-gestational periods than these five women. In addition to these characteristics, four of the five women had experienced some previous depression, which brought their predicted LMUP score down a further 0.86 to 1.35 points. They all also had scores of zero or below on all the other variables in the regression model with the exception of mother's and father's age, distance to health facility and tribe.

It therefore seems that, although in these women's cases the model predicted negative values for the LMUP, which are technically impossible, these women were unusual in their clustering a number of extreme values across several variables in an unusual combination. They were unmarried women with high numbers of children and short birth intervals, and they also had previous episodes of depression. These women would have been expected to have highly unplanned pregnancies and so the predictions from the linear regression are compatible with the theory and hypothesised relationships between various factors and pregnancy planning and do not indicate a fundamental flaw in the model.

Assessment of the logistic binary regression

Some differences were observed with regards to which factors were statistically significant between the two binary logistic models, underlining the importance of selecting the correct cut-point. Generally the difference was a small change in the size of the effect and occasionally this technically crossed the threshold for significance.

The cut point at the theoretically valid division of pregnancies into intended and unintended is more justifiable than the data driven median cut point and will be taken forward for further consideration.

Assessment of the ordinal logistic regression

There were some minor differences with regards to which factors were statistically significant in each model, such as no tribe being significantly different from Chewa in 'LMUP all' but Ngoni tribe being significantly different to Chewa in 'LMUP 3'. Like the linear regression, on 'LMUP 3' the p-value for mother's age over 30 was p=0.052, so was of borderline significance.

The validity of the proportional odds assumption for both ordinal logistic regression models was formally tested. Categorical variables and panel

variables cannot be used in the test of the proportional odds assumption so these variables were converted to a series of dummy variables. This meant that the proportional odds assumption was tested for each dummy variable individually. Since there are 25 clusters it was not considered suitable to include cluster as a fixed effect and it was therefore omitted. These tests confirmed that both models violated the proportional odds assumption at $p<0.001$.

Development of partial proportional odds ordinal logistic regression model

Where there is not proportionality of odds across response categories a partial proportional odds ordinal logistic regression can be used. Here the assumption of proportional odds is relaxed for some variables. Comparing models where all variables were constrained to the proportional odds assumption with models where no variables were constrained confirmed that the proportional odds assumption was invalidated for at least one variable in both 'LMUP all' and 'LMUP 3'. Partial proportional odds ordinal regression models were attempted for both 'LMUP all' and 'LMUP 3', however for 'LMUP all' the model could not be fitted without a large proportion of in-sample cases having a negative outcome probability.

Selection of type of multivariate regression model

There are therefore three potential regression models: linear regression using robust standard errors; binary logistic regression at the 'planned' pregnancy cut-point; and a partial proportional odds ordinal logistic regression model using the LMUP score grouped into three.

The coefficients and odds ratios for these models are shown in Table 13-5. The variables for which the proportional odds assumption had to be relaxed, of which there were six, are shaded in grey. These variables have different odds ratios in across the two cut points. By relaxing the assumption of proportional odds we are able to see which variables are associated with pregnancy intention in each of the categorisations and how their effect size differs across these cut-points (shaded in grey in Table 13-5), which is of interest in itself.

	Linear regression with robust standard errors			Binary logistic regression at 'planned' cut point			Ordinal - unplanned to ambivalent and planned combined			Ordinal - unplanned and ambivalent combined to planned			Comparison of models
	β coef.	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		
Mother's age (years)	18-29 as baseline												
- 15-17	**-1.10**	**-1.54**	**-0.65**	**0.54**	**0.40**	**0.74**	**0.45**	**0.33**	**0.61**	**0.57**	**0.43**	**0.77**	Same
- >=30	**0.39**	**0.02**	**0.76**	**1.32**	**1.02**	**1.71**	1.20	0.97	1.49	1.20	0.97	1.49	Different
Father's age (years)	20-29 as baseline												
- 15-19	**-1.44**	**-2.08**	**-0.80**	**0.45**	**0.29**	**0.69**	**0.44**	**0.30**	**0.64**	**0.44**	**0.30**	**0.64**	Same
- >=30	**0.48**	**0.24**	**0.72**	1.22	0.98	1.51	**1.32**	**1.10**	**1.58**	**1.32**	**1.10**	**1.58**	Different
Mother's education level (yrs)	-0.01	-0.05	0.03	0.98	0.95	1.01	0.99	0.97	1.01	0.99	0.97	1.01	Same
Father's education level (yrs)	-0.03	-0.06	0.00	0.98	0.96	1.00	0.98	0.96	1.00	0.98	0.96	1.00	Same
Unmarried	**-3.71**	**-4.37**	**-3.05**	**0.10**	**0.07**	**0.15**	**0.13**	**0.10**	**0.18**	**0.13**	**0.10**	**0.18**	Same
Number of live children	**-0.76**	**-0.88**	**-0.64**	**0.61**	**0.57**	**0.66**	**0.69**	**0.64**	**0.73**	**0.69**	**0.64**	**0.73**	Same
Birth interval	First birth as baseline												
- Within 24 months	**-2.07**	**-2.45**	**-1.68**	**0.35**	**0.27**	**0.45**	**0.37**	**0.28**	**0.47**	**0.26**	**0.21**	**0.34**	Same
- 2-3 years	**-0.74**	**-1.20**	**-0.27**	0.79	0.60	1.04	**0.71**	**0.54**	**0.94**	**0.44**	**0.34**	**0.56**	Different
- More than 3 years	0.33	-0.11	0.76	**1.72**	**1.29**	**2.30**	1.17	0.88	1.56	**0.71**	**0.55**	**0.91**	Different
Gestation (months)	-0.06	-0.15	0.03	0.97	0.92	1.02	**0.96**	**0.92**	**1.00**	**0.96**	**0.92**	**1.00**	Different
Socio-economic status	Poorest 20% as baseline												
- second poorest 20%	-0.13	-0.58	0.31	0.86	0.68	1.08	0.94	0.77	1.15	0.94	0.77	1.15	Same
- middle 20%	-0.13	-0.53	0.26	0.87	0.69	1.10	1.08	0.86	1.35	0.89	0.72	1.11	
- next richest 20%	0.31	-0.16	0.79	1.07	0.84	1.36	1.22	0.99	1.49	1.22	0.99	1.49	
- richest 20%	0.33	-0.23	0.89	1.01	0.78	1.31	1.22	0.98	1.52	1.22	0.98	1.52	

	Linear regression with robust standard errors			Binary logistic regression at 'planned' cut point			Ordinal - unplanned to ambivalent and planned combined			Ordinal - unplanned and ambivalent combined to planned			Comparison of models
	β coef	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		
Previous depression	None - baseline												
- 1 or 2, < 2 weeks	**-0.86**	**-1.27**	**-0.44**	**0.55**	**0.44**	**0.67**	**0.63**	**0.53**	**0.75**	**0.63**	**0.53**	**0.75**	Same
- One, ≥ 2 weeks	**-1.35**	**-1.95**	**-0.74**	**0.38**	**0.30**	**0.48**	**0.52**	**0.43**	**0.63**	**0.52**	**0.43**	**0.63**	
- Both, ≥ 2 weeks	**-1.65**	**-2.55**	**-0.75**	**0.34**	**0.17**	**0.68**	0.59	0.34	1.03	0.59	0.34	1.03	Different
Distance to health facility	<2.5km - baseline												
- 2.5 - 4.99km	0.15	-0.37	0.67	**1.38**	**1.03**	**1.86**	1.04	0.84	1.30	1.04	0.84	1.30	Different
- 5 - 7.49km	0.22	-0.49	0.93	**1.37**	**1.02**	**1.86**	1.10	0.90	1.36	1.10	0.90	1.36	
- more than 7.5km	0.18	-0.40	0.76	1.26	0.91	1.74	1.09	0.88	1.36	1.09	0.88	1.36	Same
Religion	Non-Catholic Christian as baseline												
- Catholic	-0.11	-0.44	0.21	0.96	0.81	1.13	0.93	0.81	1.06	0.93	0.81	1.06	Same
- Muslim	-0.05	-0.87	0.77	0.77	0.38	1.54	0.86	0.48	1.57	0.86	0.48	1.57	
- Other	0.09	-0.38	0.56	1.02	0.53	1.93	**2.04**	**1.04**	**3.99**	0.81	0.46	1.44	Different
Tribe	Chewa as baseline												
- Ngoni	-0.56	-1.20	0.07	**0.70**	**0.51**	**0.95**	0.76	0.59	0.98	0.76	0.59	0.98	Different
- Senga	**1.16**	**0.50**	**1.83**	0.97	0.57	1.64	**1.97**	**1.44**	**2.69**	1.97	1.44	2.69	Different
- Yao	0.17	-0.56	0.90	1.17	0.58	2.33	1.18	0.65	2.14	1.18	0.65	2.14	Same
- Other	0.10	-1.05	1.24	1.12	0.61	2.07	1.03	0.62	1.72	1.03	0.62	1.72	
rho	rho=0 not rejected			0.08	0.04	0.14	Panel variables not possible						

Table 13-5 Comparison of three multivariate regression models

The findings are relatively consistent across the models with many of the differences very borderline. The partial proportional ordinal logistic regression model is the 'best' model given that its assumptions have not been violated, but each model has different strengths and weaknesses.

Whilst it has been shown that the linear regression violates the assumptions of Normality of standardised residuals and constant variance, it is also recognised that these assumptions may be relaxed given the large sample size. In addition, and to help account for this, robust standard errors, which allow a model that contains heteroskedastic residuals to be fitted, have been used. The linear model has two significant advantages over the over models. Firstly it uses the full range of LMUP scores from zero to 12, and secondly the results enable you to see how women vary across the LMUP scale. For example, using the linear regression we can say that on average an unmarried woman has an LMUP score that is 3.72 (95%CI 3.06, 4.37) points lower than a married women, having controlled for the other variables in the model.

The main drawback of the binary logistic model, using nine as the cut-point above which the pregnancy is considered 'planned', is the resultant loss of information and efficiency having converted the ordinal thirteen-point scale to a binary outcome. It also only gives us an estimate of effect over one cut-point.

It was not possible to calculate a stable partial proportion odds ordinal logistic regression model using the whole LMUP score meaning the scores had to be collapsed to the three groups. This has again resulted in a loss of information and efficiency, however we now have estimates of effect across two cut-points as opposed to one as in the binary logistic model. The interpretation of these odds ratios is less intuitive. For number of live children, which does not violate the proportional odds assumption and therefore has the same odds ratios across both cut points, we can see that for every additional child a woman in the unplanned or ambivalent group has 0.69 (95% CI 0.64, 0.73) the odds of being in the ambivalent or planned group respectively. For mothers aged 15-17, a dummy variable that does not have proportional odds, women have 0.45 (95%CI 0.33, 0.61) the odds of being in the ambivalent or planned groups rather than in the unplanned group and 0.57 (95%CI 0.43, 0.77) the odds of being in the planned group rather than the unplanned or ambivalent groups.

There are few studies that have compared different types of regression or cut-points on the same data. Norris et al., for example, compared linear, logistic and ordinal regression models, using two different cut-points for the logistic regression and the proportional odds model, to analyse quality of life data (407). They found that the linear and ordinal regressions had 'similar *and smaller confidence end-point ratios [the upper confidence interval divided by the lower confidence interval, a measure of parameter stability] when compared to the binary logistic models'* indicating that these models were more precise. It should be remembered though that these two models are not strictly comparable as in the logistic regressions the size of the confidence interval depends in part on the magnitude of the odds ratio. They

also noted that the interpretation of these models was simpler. However, no one model is *de facto* better than any other and the choice of model should depend on the aim of the analysis and considerations of model goodness of fit. It was with this in mind that I selected the linear regression model because it offered more insight than the binary logistic regression, the differences between it and the partial proportional odds were minimal and the interpretation of the linear regression is more intuitive.

Appendix X Published paper on the validation of the Chichewa LMUP

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RESEARCH ARTICLE Open Access

Understanding pregnancy planning in a low-income country setting: validation of the London measure of unplanned pregnancy in Malawi

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Abstract

Background: The London Measure of Unplanned Pregnancy (LMUP) is a new and psychometrically valid measure of pregnancy intention that was developed in the United Kingdom. An improved understanding of pregnancy intention in low-income countries, where unintended pregnancies are common and maternal and neonatal deaths are high, is necessary to inform policies to address the unmet need for family planning. To this end this research aimed to validate the LMUP for use in the Chichewa language in Malawi.

Methods: Three Chichewa speakers translated the LMUP and one translation was agreed which was back-translated and pre-tested on five pregnant women using cognitive interviews. The measure was field tested with pregnant women who were recruited at antenatal clinics and data were analysed using classical test theory and hypothesis testing.

Results: 125 women aged 15–43 (median 23), with parities of 1–8 (median 2) completed the Chichewa LMUP. There were no missing data. The full range of LMUP scores was captured. In terms of reliability, the scale was internally consistent (Cronbach's alpha = 0.78) and test-retest data from 70 women showed good stability (weighted Kappa 0.80). In terms of validity, hypothesis testing confirmed that unmarried women ($p = 0.003$), women who had four or more children alive ($p = 0.0051$) and women who were below 20 or over 29 ($p = 0.0115$) were all more likely to have unintended pregnancies. Principal component analysis showed that five of the six items loaded onto one factor, with a further item borderline. A sensitivity analysis to assess the effect of the removal of the weakest item of the scale showed slightly improved performance but as the LMUP was not significantly adversely affected by its inclusion we recommend retaining the six-item score.

Conclusion: The Chichewa LMUP is a valid and reliable measure of pregnancy intention in Malawi and can now be used in research and/or surveillance. This is the first validation of this tool in a low-income country, helping to demonstrate that the concept of pregnancy planning is applicable in such a setting. Use of the Chichewa LMUP can enhance our understanding of pregnancy intention in Malawi, giving insight into the family planning services that are required to better meet women's needs and save lives.

Keywords: Pregnancy intention validation Malawi measure unplanned

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Background

80 million women in developing countries experienced an unintended pregnancy in 2012 resulting in an estimated 30 million unplanned births, 40 million abortions and 10 million miscarriages [1]. 63 million of these unintended pregnancies are at least in part a consequence of the fact that 222 million women worldwide have an unmet need for family planning [1].

Whilst all pregnancies expose women to some risk, unintended pregnancies expose women to these risks unnecessarily and without them making the decision to take on these potential risks for the benefit of having a child. In developing countries pregnancy can carry an extremely high risk of morbidity and mortality; in 2012 approximately 291,000 women in developing countries died from pregnancy-related causes. That 104,000 of these women will not have wanted to become pregnant in the first place makes this even more of a tragedy. Were the unmet need for family planning fully met it is calculated that 79 000 maternal deaths could be prevented each year [1]. The majority of these would be in sub-Saharan Africa where there are high levels of both unmet need and maternal mortality.

In order to meet the unmet need for family planning we need to develop a better understanding of women's pregnancy intentions and behaviours. Most current estimates of the levels of unplanned pregnancy in developing countries are derived from questions used in the Demographic and Health Survey (DHS). The standard DHS question asks "At the time you became pregnant, did you want to become pregnant then, did you want to wait until later, or did you not want to have any (more) children at all?" Whilst this has provided useful information, there has been increasing discussion of the limitations of these types of questions and of the need to develop a more sophisticated method for measuring this complex construct [2-9].

The London Measure of Unplanned Pregnancy (LMUP) is a new tool for measuring the degree of pregnancy intention of a current or recent pregnancy [3]. It was developed in the United Kingdom (UK) [4] and has subsequently been formally translated and validated in India and the United States of America [10,11] with unvalidated translations in use elsewhere. By asking six questions, each scored zero, one or two, the LMUP scores pregnancy intention on a continuous scale from zero to 12 with each increase in score representing an increase in the degree of pregnancy intention [3]. By scaling intention in this way the dichotomisation of pregnancies into planned and unplanned is avoided and women are able to express ambivalence. The questions cover contraceptive use, timing, intention, desire for a baby, discussion with the partner and pre-conception preparation (see http://www.lmup.co.uk for the full English version).

The LMUP has the potential to be a useful tool for understanding pregnancy intention in a range of settings but must be translated and validated prior to use outside of the context in which it was developed. The aim of this study was to translate and validate the LMUP for use in the Chichewa language in Malawi using classical test theory.

Malawi is a low-income country ranking 170 out of 187 countries in the Human Development Index. It has a high maternal mortality of 460 per 100 000 live births [12] and 26% of married women have an unmet need for family planning leading to 45% of pregnancies being reported as unplanned [13]. These factors make it an ideal candidate to be the first location for a validation of the LMUP in a low-income country. The research was conducted in Mchinji District, a Chichewa speaking district in the central region of Malawi. Mchinji has an estimated population of 530,218 people with 23% (121,950) being women of childbearing age (Mchinji socio-economic profile 2012, unpublished).

Methods

The LMUP was originally designed for self-completion. Given the low levels of literacy in Mchinji District [13] this was not felt to be a viable option. The LMUP was therefore adapted for interviewer-administration along the same lines as the Indian validation [11].

The interviewer-administered English LMUP was sent to three native Chichewa speakers (two female, one male, all involved in health research) who each independently translated it into Chichewa. All translators were given a short briefing on the purpose and background of the LMUP prior to conducting the translation. The three translations were reviewed by JH and the differences were discussed at a consensus meeting of the three translators plus a locally trained nurse-midwife and health researcher. The agreed translation produced by this meeting was sent for back-translation to a native English speaker who spoke Chichewa fluently as a second language. This person was only broadly aware of the purpose of the LMUP.

Following back-translation the Chichewa LMUP was pre-tested using cognitive interviewing techniques. The aim of these interviews was to gauge the ease with which women understood the questions, to check the translation and to assess the acceptability of the questions. Pregnant women were recruited for these interviews from Mchinji District Hospital (MDH) antenatal clinic.

The final version of the Chichewa LMUP was field-tested at three antenatal clinics in Mchinji District: MDH, Kochilira Community Hospital and Ludzi Community Hospital. Three women living in these areas who had previously worked with our organisation were trained to conduct the interviews. All pregnant women aged 15 or over attending any one of these clinics in the

Four of the five understood that family planning was a way of 'stopping pregnancy' but it seemed that the women were interpreting the Chichewa word 'zolerera' too narrowly. There was not a better word available and so it was decided that we would preface the question with some additional information to help the respondents. The text that was added was:

'This question asks about contraception. This might include condoms, pills, injections, implants, coils, vasectomy, female sterilisation or any other method aimed at delaying pregnancy'.

The second change that was made was to alter the options available for question six, pre-pregnancy preparations, to include the more contextually relevant option 'saved money for healthcare.' This is not applicable in the UK but is relevant in the Malawian context and indeed was included in the Indian validation. Discussion with local women and midwives indicated that the smoking and alcohol responses were unlikely to be relevant in this context however the decision was made to include them in the field test and base their inclusion or exclusion on the data collected.

Field-test: women's characteristics

Data were collected from one hundred and twenty five women, surpassing the target of 100. Women were aged

Table 1 Characteristics of women completing the London Measure of Unplanned Pregnancy (LMUP) field test and re-test compared to the averages for Mchinji District and Malawi as a whole where available in the Demographic and Health Survey (DHS)

Socio-demographic characteristics	LMUP field test n = 125	LMUP retest n = 70	LMUP non-retest n = 55	Comparison of retest and non-retest groups	Mchinji DHS 2010 data[i]	Malawi DHS 2010 data[i]
Age						
Mean (sd)	24.4 (5.9)	25.03 (6.1)	24.4 (6.3)	P = 0.3120		
Median	23	25	22			
Range	15 – 43	15 - 41	16 - 43			
Age group	**N (%)**	**N (%)**	**N (%)**			
15-19	28 (22.4)	14 (20)	14 (25.5)			
20-24	41 (32.8)	20 (28.6)	21 (38.2)			
25-29	28 (22.4)	19 (27.1)	9 (16.4)			
30-34	19 (15.2)	13 (18.6)	6 (10.9)			
35-39	7 (5.6)	3 (4.3)	4 (7.3)			
≥40	2 (1.6)	1 (1.4)	1 (1.8)			
Children						
0	39 (31.2)	21 (30)	18 (32.7)	P = 0.2549		
1	35 (28.0)	16 (22.9)	19 (24.6)			
2	23 (18.4)	15 (21.4)	8 (14.5)			
3	10 (8.0)	5 (7.1)	5 (9.9)			
≥4	18 (14.4)	13 (18.6)	14 (25.5)			
Marital status						
Married	101 (80.8)	54 (77.1)	47 (85.5)	P = 0.242	68%	81.3%
Unmarried	24 (19.2)	16 (22.9)	8 (14.5)		32%	19.7%[ii]
Education						
None	6 (4.8)	3 (4.3)	3 (5.5)	P = 0.978	18.2%	15.2%
Primary	87 (69.6)	48 (68.6)	39 (70.1)		64%	64.8%
Secondary	29 (23.2)	17 (24.3)	12 (21.8)		17.8%	18.1%
Tertiary	3 (2.4)	2 (2.9)	1 (1.8)		0%	1.8%
Partner's occupation	Missing data for 5		Missing data for 5			
Unemployed/Student	10 (8.3)	5 (7.1)	5 (10)	P = 0.076	7.9%	18%
Agriculture/Casual labour	53 (44.2)	37 (52.9)	16 (32)		72.4%	82%
Employed/Business man	57 (47.5)	28 (40)	29 (58)		19.7%	

[i]DHS data refers to all women all aged 15–49 and not only to pregnant women [ii]Never married rather than currently unmarried.

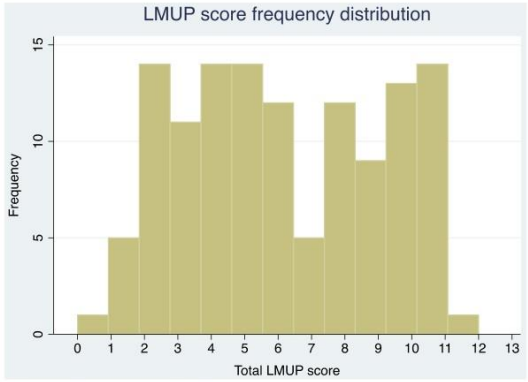

Figure 1 Distribution of Chichewa London Measure of Unplanned Pregnancy (LMUP) scores.

from 15–43 (median 23, mean 24.5) and had between zero and seven live children (median 1). Eighty percent of the women were married and the majority (69.6%) had primary education only (see Table 1).

Field test: psychometric properties

There were no missing data and no question had a response with more than 80% endorsement. The full range of LMUP scores from zero to twelve was captured in the field test (see Figure 1). The median score was 6.

The Cronbach's α for the whole scale was 0.78. Item-rest correlations were above or around 0.7 for questions two to five, was borderline for question six (0.16) and was low for question one (0.05) (see Table 2).

74 women returned for the re-test but due to interviewer error data were only available on 70. The women who returned for the re-test were not significantly different from those who did not return in terms of age, parity, number of live children, marital status, education or partner's occupation (see Table 1). The average test-retest interval was 7 days (range 5–10 days). The median difference in the scores at test and re-test was zero (mean –0.2). The weighted κ statistic was 0.799 and the Pearson correlation coefficient was 0.801 showing good stability.

Hypothesis testing confirmed that women who already had four or more children alive ($p = 0.0051$), unmarried women ($p = 0.003$), and women who were below 20 or over 29 ($p = 0.0115$) were all more likely to report their pregnancies as more unintended (see Figure 2, Figure 3, Figure 4).

Principal component analysis confirmed that five items clearly measured one construct loading onto one component with an Eigenvalue of 3.1. A second component was of borderline significance with an Eigenvalue of 1.00 and mainly represented the question on contraception (loading of 0.99), in keeping with the lower item-rest correlation (see Table 2).

Table 2 Principal component analysis of Chichewa London Measure of Unplanned Pregnancy

		Component 1 (Eigenvalue = 3.1)	Component 2 (Eigenvalue = 1.0)
Items	**Item-rest correlations**	**Item loadings**	**Item loadings**
1 - Contraception	0.05	–0.04	*0.99*
2 - Timing	0.69	*0.48*	0.07
3 - Intention	0.79	*0.51*	–0.02
4 - Desire	0.74	*0.50*	0.06
5 - Partner	0.72	*0.48*	–0.03
6 - Preparation	0.16	*0.14*	0.07

Field test: sensitivity analysis

The LMUP was re-analysed without the question on contraception use. This reduced the LMUP scores to zero to 10 and gave a median score of 4 for our data. Cronbach's α increased from 0.78 to 0.83 and all items loaded on to one component with an eigenvalue of 3.10. All hypothesis tests remained statistically significant (data not shown).

Finalisation of the Chichewa LMUP

The responses to the question on pre-pregnancy preparation were inspected to determine which options should remain in the final version of the Chichewa LMUP. No

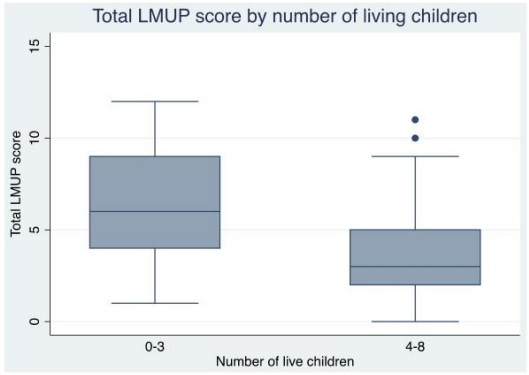

Figure 2 Box plot showing median and inter- quartile range of London Measure of Unplanned Pregnancy (LMUP) score by number of living children.

respondents reporting cutting down on smoking (99.8% of women in Mchinji do not use any form of tobacco [13]) and only one woman reported cutting down on alcohol. These items were therefore removed from the final version of the Chichewa LMUP.

Discussion

The validation of the Chichewa LMUP using classical test theory shows that the Chichewa LMUP meets the pre-set criteria for acceptability, endorsement, targeting, internal consistency, reliability and construct validity by hypothesis testing. The original English LMUP has now been translated and validated into five other languages in high-, middle- and low-income countries. Although analysis by classical test theory shows slightly weaker performance by all translations than the original, they remain acceptable (see Table 3).

The only slight deviation from the pre-set criteria for the Chichewa LMUP was on the principal component analysis. Here all items were expected to load onto one component with an Eigenvalue larger than one thus demonstrating that all components are measuring the same construct. In actual fact they loaded onto two components with an Eigenvalue larger than one,

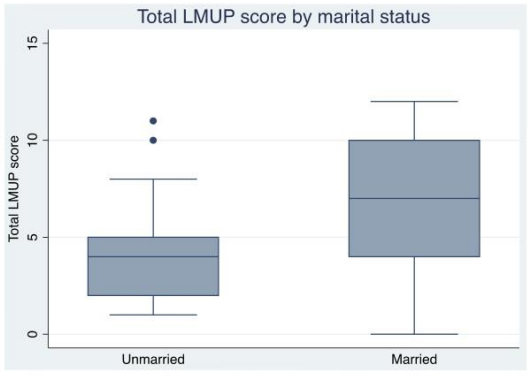

Figure 3 Box plot showing median and inter- quartile range of London Measure of Unplanned Pregnancy (LMUP) score by marital status.

Figure 4 Box plot showing median and inter- quartile range of London Measure of Unplanned Pregnancy (LMUP) score by age group.

although the second component had an eigenvalue of 1.00 making it very borderline. The same thing was found in the Indian validation and it was noted that the 'second component … mainly represented item one [contraception] (loading of 0.78)' [11]. In the Chichewa LMUP this was also true with the second component almost entirely representing the question on contraception (loading of 0.99). The Mokken analysis conducted in the USA validation indicated that the contraception question 'was not contributing greatly to the scale [but] the scale was still strong with the inclusion of this item' [10].

In the original LMUP not using contraception was more strongly associated with intention to become pregnant than it appears to be in any of the subsequent translations. In the Malawian setting this might be explained by the fact that there is a high unmet need for family planning i.e. 27% of married women who do not want another pregnancy in the next two years are not using any form of family planning [13]. In this context the relationship between not using contraception and wanting to get pregnant is diluted. Similar factors may also be at play in the Indian setting and in the USA study that was conducted in low-income women. We recommend retaining the question on contraception in the Malawian setting for several reasons. Firstly, the scale is not compromised by its retention, secondly if the LMUP is used over time we may see this item becoming more relevant as unmet need for family planning falls and, finally, to enable easier comparison with LMUP use elsewhere.

Limitations

There are three main limitations to this study. Firstly, in Malawi abortion is illegal so we were not able to test the LMUP in women who we knew were and were not planning to continue the pregnancy to term. Despite this the Chichewa LMUP could be used in women following induced or spontaneous abortion as it was developed and validated with abortion as an outcome of pregnancy in the original UK development [3]. Secondly, we were only able to conduct a test-retest analysis during pregnancy. Subsequent work is underway that will allow a postpartum re-test analysis to be conducted. Finally, we recruited women from antenatal clinics meaning that we missed women who do not attend for antenatal care. Although in Mchinji District over 90% of women receive antenatal care from a skilled attendant at least once during their pregnancy [13] the 10% of women who do not attend are likely to be significantly different from those who do in many ways. This might account for why the women in this study tended to have higher levels of education and of partner employment than was expected from the district level data in the DHS as seen in Table 1.

Table 3 Comparison of results of classical test theory analysis for validation of the original London Measure of Unplanned Pregnancy and its translations

	Internal consistency Cronbach's α	Eigenvalues of principal component analysis components	Test retest weighted κ
UK	0.92	4.33	0.97 and 0.86
USA - English	0.78	2.9	0.72
USA - Spanish	0.84	3.4	0.77
India - Kannada	0.76	2.66 and 1.05	0.43
India - Tamil	0.71		
Malawi	0.78	3.1 and 1.00	0.80

Conclusion

The Chichewa LMUP is a valid and reliable measure of pregnancy intention in women who speak Chichewa and is now an available tool for research and surveillance in Malawi. It is the first time the LMUP has been formally validated in a low-income country and in so doing it helps to demonstrate that the concept of pregnancy planning is applicable in these settings. The Chichewa LMUP represents a methodological advance on the DHS-style pregnancy intention questions, particularly by allowing a more nuanced picture of pregnancy intention and planning, and can be used for a range of research questions pertaining to pregnancy intention such as enhancing understanding of pregnancy planning behaviour or investigating relationships between pregnancy intention and maternal and neonatal health. This should lead to insights for the provision of family planning programmes to aid Malawi in designing programmes to meet the unmet need for family planning and reduce maternal and child deaths.

Abbreviations

DHS: Demographic and Health Survey; LMUP: London Measure of Unplanned Pregnancy; MDH: Mchinji District Hospital; PDA: Personal digital assistant; PCA: Principal component analysis; UK: United Kingdom; USA: United States of America.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JH and GB designed the study with the support of JS and AM. JH and NM trained the fieldworkers and oversaw the data collection process. JH analysed the data with advice and input from GB and AC. JH wrote the first draft of the article, which all authors contributed to. All authors have read and approved the final manuscript.

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Appendix Y Topic guide for focus group discussion on postpartum family planning

Good morning/afternoon and welcome to our discussion today. Thank you for taking the time to join us. My name is _____ from MaiMwana Project, assisting me is _____ , also from MaiMwana Project. For the last 18 months MaiMwana Project has been conducting research on pregnancy planning, which some of you have been involved in. As part of this work we are now trying to learn about how women and men in Mchinji District feel about family planning, in particular using family planning shortly after a baby has been born. This is known as postpartum family planning. We have invited you all here as you have recently had a baby and we would like to hear about your experiences, perceptions, ideas and desires with regards to postpartum family planning.

Before we begin I would like to go over some ground rules for our discussion. It is important to remember that there are no right or wrong answers, just different points of view. In this discussion we will not be using names, instead you will be given a number. Please feel free to share your opinions even if they differ from what others have said – often this is some of the most useful information for us – but please do respect other's views. When you talk please speak up and try to make sure that only one person is speaking at a time. We will be recording the session because we don't want to miss any of your comments. If several people talk at the same time it will be hard for us to hear what is being said and we might miss something. We might take some notes during the discussion; this is just to help us when we come to review the discussions later.

We will be using numbers during the discussion. Some of things that we might talk about today are quite personal. You can be assured of complete confidentiality from us and we ask that you extend this confidentiality to each other. This means that you should not discuss the specifics of what people have said in this group with people from outside the group.

Our session will last between 1.5 and 2 hours and we will not be taking a formal break. At the end of the discussion we will have some refreshments. Are there any questions before we start? Ok, then to get us started and to learn a little bit about each other I'd like us to go around the room one at a time and tell the group your number, how many children you have and what your favourite leisure activity is.

Topic area 1 - Norms and expectations relating to family size and birth spacing

We've just heard that the people in this room have between __ and ___ children. How many children do you think is the ideal number to have in a family?

- What makes you say __?

How do you think men differ with regards to the number of children they would like? In what way does this influence you, or does it not influence you?

If you could choose the length of time between having one child and the next, what would your preference be?

- What makes you say __?
- What sort of things might affect your ideal length of time between having one child and the next?
- How do people achieve their ideal length of time between children?

Topic area 2 Knowledge and perceptions of family planning methods

Just so that we are all talking about the same thing I'd like to ask what you understand by the term 'family planning?'

What sort of methods of family planning are you aware of?

For the rest of the discussion when we use the term 'family planning' we are talking about the modern methods, like depo, pills, implants and so on, and not the traditional methods such as the chingwe.

How do you feel about these methods of family planning?

Does anyone have any experience of using any of these methods that they would like to share with the group?

What are some of the things that you like about any of these methods of FP?

And what do you dislike about them?

Is anyone aware of any particular issues with any of these methods, either from your own experience or from women that you know?

How has this influenced your opinions on FP, if it has?

Who has been important in shaping your opinions on FP?

What else has influenced your opinions on FP?

Topic area 3 - Use of family planning services

If you wanted to use FP how easy or difficult would it be for you to access FP services?

What is it that makes it easy/difficult?

What role, if any, does your partner play in your decision to use FP services? Does anyone else in your community influence your decision to use FP services?

What role, if any, does your partner play in your ability to access FP services? Does anyone else in your community influence your ability to access FP services?

Where do / would you prefer to access FP services from? What is it about these services that make you prefer them?

How do you think the current services could be improved so that women would be more likely to use them?

Topic area 4 - Postnatal check and PPFP

I'd like to move on for a moment to talk about postnatal checks. The government advises that women have a postnatal check-up for their own health shortly after the birth of their baby. What do you think about this? Do you think that this is useful? What makes you say it is / is not useful?

How easy or difficult is it for you to go for a postnatal check within the first week after birth? What makes it easy / difficult?

If you think it would be useful, what are the kinds of things that you would like to discuss with a health worker about your own health at a postnatal check?

If struggling prompt e.g. breastfeeding, wound healing, mental health…

Do you think that this is a good time to talk about FP options after you have given birth?

- What makes you say that?
- When would you prefer?
- Who would you prefer to talk to?
- Would you prefer to do this at the health centre, at home or somewhere else?

How do you feel about using family planning after having given birth?

- How do you decide whether or not you are going to start using FP?
- How do you decide when you are going to start using FP, if you are?
- If you decided to use FP about how long after the birth would you prefer to start using it? What makes you say that?
- What information would help you decide whether or not to start using FP after the birth?
- Which method of FP would you prefer to use at this time? Why is that?

- How well are you able to access this information at the moment? How could this be improved?
- Are any of the issues with FP that you mentioned before, e.g. (give example here) of particular concern after having given birth?
- Are there other concerns that you have about using family planning at this time?

How do you think you partner feels about you using family planning after having given birth? And what about other people in your community?

Closing

If you had a chance to advise Dr Chimwemwe Banda, the Mchinji District Health Officer, on how to improve women's use of postpartum family planning, what advice would you give him?

This discussion has been really helpful for us to try to understand how you feel about FP, in particular in the time after you have given birth. Before we finish is there anything that you think we have missed? Or anything you that you didn't get a chance to say?

Thank you again for your time, it has been very helpful for us. We have several more discussions like this to do before we will be able to reach any conclusions but if you would like to know more about what we find please get in touch with me after the session. We will now have some refreshments.

Appendix Z Thematic framework for analysis of focus group discussions

Theme 1 - ideal number and spacing	Theme 2 - family planning	Theme 3 - PN check	Theme 4 - PPFP	Theme 5 - DHO advice
Current number of children	Barriers	Access	Method	FP in villages
Spacing of current children	Availability	Compliance	TL	examine the woman
Ideal spacing	Desire	Difficult	condom	improve availability
Number of children wanted	Following instructions	Easy	depo	improve ppfp at delivery
Problems with spacing limiting	Frequency	Timing	loop	male involvement
Desire	Misconceptions	Why don't go	norplant	visit the areas
FP not available	Need for future family	Why its useful	other	
FP not working	Religion	FP	pills	
Fear or SE	Side effects	Advice on child care	Reasons not to start	
Lacked means or knowledge	Body pains	Breastfeeding and diet	What other people think	
Partner influence	abn bleeding on depo	Husband	When started	
Problems accessing FP	causes disease	Hygiene	When to discuss	
Start FP late	dizzy	ITN	HSA in village	
wanted break	intereferes with work	Immunisations	antenatal	
Reasons for ideal spacing	interferes with sex	Advice on sex	delivery	
Caring for child	sore breasts	Check baby	pn check	
Child care for child	Stigma	Check mother	under 5 clinics	
Child health	Blood	Problems	Who discuss with	
Child walking	Benefits of FP		HSA	
Cost	Current FP use		doctor	
Growth	Facilitators		nurse	
Home development	Access in villages		Who influences decision	
Mother's health	Choice		HCW	
Chores	Cost		friends or community	
ageing	Duration		group discussion	
Nutrition	IEC		partner	
Peaceful household	Local leaders		radio	
School	Not changing feeling		tradition	
Reasons for number of children wanted	STI prevention		yourself	
Care for child	Methods known about		Why started	
Child health	Preferred method		Allow child to grow	
Enough	Previous FP used		Avoid UIPs	
Growth	Role of others		Home development	
Household budget	HCW		Household budget	
Land and farming	chief or community		Woman's health	
Mother's health	family		feels good to use FP	
ageing	friends		to have sex	
Population	Role of partner		Traditional practices	
Poverty	What is FP			
School	Where to get FP			
What men think wives want				
What women think husbands want				
Changing norm of family size				